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THE UNIVERSITY OF ALBERTA

EVALUATING INDUSTRIAL AND REGENERATIVE PARADIGMS FOR AGRICULTURAL SUSTAINABILTY

by

STEVEN RAY LARRICK

(C)

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

IN

RURAL SOCIOLOGY

DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

FALL, 1988

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ISBN 0-315-45502-0

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DEGREE FOR WHICH THESIS WAS PRESENTED: MASTER OF SCIENCE

YEAR THIS DEGREE GRANTED: FALL, 1988

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies and Research for acceptance a thesis entitled "Evaluating Industrial and Regenerative Paradigms for Agricultural Sustainability," submitted by Steven R. Larrick in partial fulfillment of the requirements for the degree of Master of Science in Rural Sociology.

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.....

Date August 25, 1988

ABSTRACT

This macrosociological study grows out of a concern for the long-term sustainability of North American agriculture, both as an ecosystem and as a social system. It presents an overview of values and practices prevalent in two broadly-defined scientific paradigms and evaluates the potential of each to promote the long-term maintenance and enhancement of agricultural systems.

The dominant **industrial paradigm** has resulted in dramatic productivity increases in agriculture for more than a century through the application of manufacturing principles and practices to farming. Since the second Club of Rome report, however, this paradigm has come under increasing criticism for contributing to the rapid consumption of finite fossil fuels, high levels of pollution, and the displacement of much of the farm population.

An alternative orientation for agriculture is emerging in the form of what is described as the **regenerative paradigm**. The focus of this paradigm is on the application of ecological principles in order to reduce resource depletion, reduce pollution, enhance biological efficiency, and provide greater and more diverse opportunities for employment in agriculture.

Critical to the evaluation of these scientific paradigms is the development of a conceptual model which provides a contextual perspective of long-term developmental relationships. Fundamental relationships reflected in the model include life's growing complexity and integration in the face of entropy, the dual nature of healthy development in social betterment and ecological conservation, and the recognition of a process of circular, cumulative causation toward decline or improvement.

PREFACE

This thesis is the culmination of 18 years of study and contemplation by the author in trying to identify common roots to problems in the farm economy, in agriculturally-based rural communities, and in the agricultural environment in North America.

During this period, an awareness of the economic dimensions of the farm crisis was developed while majoring in economics as an undergraduate at Grinnell College in Iowa. The problems of declining agriculturally-based communities were experienced first-hand as a community development specialist for five years with the Nebraska Department of Economic Development. An appreciation for the complexity and beauty of agricultural environments was furthered in work as a ranch-hand on an 11,000 acre ranch in the Nebraska Sandhills; as an organizer of a community garden project in the predominantly Cree community of Wabasca, Alberta; and as a worker at the Eyot Creek Farm, an 80 acre organic vegetable and cheese farm near Leduc, Alberta.

As a student of rural sociology for the past four years, this researcher has sought to develop a conceptual framework through which the social and ecological problems of agriculture could be dealt with from an integrated scientific perspective. It was felt that with such an integrated scientific perspective, we could begin to direct agriculture toward long-term sustainability in a more comprehensive and systematic way.

ACKNOWLEDGEMENTS

Investigating the notion of long-term agricultural sustainability at the University of Alberta over the past four years has been a great learning experience. With outstanding facilities and resources, the university provides a high-quality base of study for students.

In my thesis committee, made up of Dr. Dhara Gill, Dr. Linda Chase-Wilde and Dr. Harry Garfinkle, I was fortunate to have had a group of professors dedicated to freedom of expression and the pursuit of truth.

Though the subject and approach which I have chosen were not universally popular within the Department of Rural Economy, there were numerous exchanges of ideas which resulted, I hope, in valuable learning experiences for all.

I am thankful to Reg Norby for his tireless work in behalf of the students in the Department of Rural Economy and to Dr. W.B. McGill and Dr. Jim Robertson from the Department of Soil Sciences for their expressions of interest and helpful suggestions concerning the ecology of agriculture.

For their kind support through the long and trying ordeal of completing this thesis, I would like to give special thanks to my wife, Janine, and to four friends: Tom Grauman, Wendy Neander, Josie Stein, and Sharon Rempel, the energetic past-president of the Sustainable Agriculture Association of Alberta.

Last but not least, I would like to thank my parents, Carl and Lillian, and the rest of my family, whose love and support have helped me to fulfill this dream.

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CHAPTER I

INTRODUCTION

A. Background to the Problem

In this study, two broadly-defined paradigms are evaluated in terms of the likelihood of promoting long-term ecological and social sustainability in North American agriculture. In the **industrial paradigm**, agriculture is considered to be just like any other industrial enterprise and is structured accordingly. In contrast, advocates of a **regenerative paradigm** view agriculture primarily as a biological system and would structure it as such.

The term **paradigm** was coined by Kuhn to signify an "entire constellation of beliefs, values, techniques, and so on shared by the members of a given community."(Kuhn, 1970, p. 175) In each paradigm, the corresponding scientific community sets the acceptable parameters of fact collection, theory articulation, methodology and development patterns. (Kuhn, 1970, p. 103)

There are overlapping features in the two paradigms discussed here, but for analytical purposes this thesis will focus on the differences. These differences can be better understood within the historical context from which they arose.

(1) A History of Agricultural Failures

Human societies have often found great difficulty in developing agricultural systems which are sustainable over long periods of time. Since the beginning of humanity's 6,000 year history in agriculture, Carter and Gill have argued, "Civilized man has despoiled most of the lands on which he has lived for long."(1974, p. 7) Depending on how one defines "civilization," between ten and thirty civilizations have

collapsed because of a failure to properly adapt agricultural systems to the requirements of the natural resource base.(Carter and Gill,1974,p.8)

In the wake of these failures, vast areas of once-fertile land have been left unproductive for centuries. Where the Medes and Persians once prospered in western Iran, where the Assyrians once farmed in northern Iraq, and where other cultures once farmed in Syria, Lebanon, Palestine, Algeria, Tunisia, Crete, Greece, Italy, Sicily, and parts of Asia Minor, much of the land has been severely depleted. The scale of soil depletion in these and other areas of the globe has prompted one analyst to suggest that agriculture may be the most destructive force in geological history.(Jackson,1980)

When the predominantly European settlers arrived on the North American continent, they found a land of rich abundance, preserved for centuries by a prevalent environmental ethic among Native Americans. Chief Seattle expressed this ethic when he said, "Man did not weave the web of life; he is merely a strand of it. Whatever he does to the web, he does to himself."(De Groot,1985) This statement reflects an awareness that agricultural systems which are environmentally degrading are likely to be degrading to their respective societies as well.

This holistic, ecological attitude was not shared by most Europeans settling the North American continent. Rowe argued that, "From the earliest European settlements, the pattern of behavior in North America has been one of **take from** rather than **care for**."(1984,p.53) Many settlers took the abundance of the new land to be a license to exploit one farm and move on to virgin soil. In effect, the abundance of land and resources contributed to "both a

transitoriness in America and to poor husbandry."(Johnson, 1978, pp.64-65) This early assumption of unlimited new land is not unlike the assumption in recent decades of unlimited of fossil fuels.

Early environmental degradation and depletion brought about by North American agriculture was recognized and criticized by conservationists such as Henry David Thoreau, John Muir and Aldo Leopold. As early as 1909, Robert LaFollette, editor of *The Progressive*, observed that:

> We have thought our farmers the best in the world; but we now learn that lands in the old world which have been farmed since the beginning of the Christian era are less exhausted than fields tilled by us for fifty years...We have acted like tenants-at-sufferance of a farm, 'skinning' it of its best, and spoiling it for the next comer.(Polsgrove, 1984, p.22)

Depletion of agricultural lands in North America reached a critical point in the 1930s when dust storms swept across the continent. That period of ecological crisis prompted a desire to better understand and cooperate with nature in agriculture. (Worster, 1977) Through the 1940s and early 1950s, a substantial amount of conservation work was done, resulting in the adoption of some sound farming practices.(McGill, 1985, p.182)

Although long-term agricultural sustainability has been elusive through much of human history, there is substantial evidence that particular agricultural systems have struck a healthy balance between food production and the requirements of respective natural resource bases. King's Farmers for Forty Centuries and recent literature on Amish farming in the U.S, are instructive in this regard. These and other examples suggest that continued debasement of ecological and social systems in agriculture is not inevitable.

(2) Agricultural Industrializaton in North America

The dominant **industrial paradigm** has resulted in dramatic productivity increases in North American agriculture for more than a century through the application of manufacturing principles and practices to farming. The three basic principles of industrial practice applied to agriculture are:

(a) Mechanization--The progressive replacement of human and animal labor with increasingly large machinery driven by fossil fuels;

(b) Intensification--Dramatic increases in the level of inputs such as irrigation and the application of petroleum- based fertilizers and pesticides, and herbicides; and

(c) Specialization--The abandonment of diversified farm systems and crop rotations for monoculture production.

Impressive results were achieved in industrialized agriculture through initially small amendments to the resource base. This early success led to massive federal support for industrial technologies in agriculture in the form of direct government subsidies, preferential tax treatment and billion-dollar research programs which contributed to large-scale industrial production systems. (Hightower, 1978)

The resulting industrial technologies have had a profound impact on the structure of North American agriculture. From 1940 to 1980, the number of farms in the U.S. dropped from over 6 million to less than 2.5 million; the size of the average farm increased from 157 acres to 429 acres; and the farm population dropped from over 30 million to less than 7.5 million. (USDA, Agricultural Statistics, various years) This rapid depopulation of farm areas drew relatively little organized protest during this period, largely because job opportunities awaited

most displaced farm families in urban manufacturing and service industries.

Through much of the 1960s and 1970s, agricultural experts pointed to the increased productivity of agriculture and boasted that the main problem in global agriculture was how to spread similar industrial technologies, in the form of a "**Green Revolution**," to the rest of the world. Many continue to believe that global industrialization of agriculture is the answer to long-term agricultural needs.

(2) The Emerging Regenerative Agriculture Movement

Euphoria over the short-term productivity increases derived from energy- and capital-intensive agriculture has gradually been diminished by a growing awareness of long- term ecological and social costs. Since the second Club of Rome report, the industrial paradigm has come under increasing criticism for contributing to the rapid consumption of finite fossil fuel reserves, high levels of pollution, and the displacement of much of the farm population.

An alternative orientation for agriculture is emerging in the form of the **regenerative paradigm**. The focus of this paradigm is on the application of ecological principles to agriculture in order to reduce resource depletion, reduce pollution, enhance biological efficiency, provide greater and more diverse opportunities for employment in agriculture, and strengthen rural development initiatives. This broad-based social movement in North America is beginning to question two prevailing assumptions of agricultural industrialization:

(a) that the negative ecological and socio-economic impacts of the industrial technologies are part of the inevitable price of progress; and

(b) that the resource base is static with little economic impact on long-term production.(McGill,1985)

Critics of the view that problems resulting from the current structure of agriculture are the inevitable cost of technological progress have been labeled as "anti-chemical, anti-science and anti-technology."(Borlaug,1986,p.7) In response, supporters of alternative agricultural systems point out that they "are not against technology and they are definitely not against progress. They are against the misuse of technology."(Wolf,1978,p.17)

Critics of certain industrial practices point to past agricultural breakdowns and argue a similar collaspe is possible in North American agriculture. History has shown, they say, that the faster and more forcefully agriculture has been developed, the faster and greater the ecological degradation has often been.(Carter and Gill,1974,pp.8,24) They argue that industrial agriculture systems have the potential for depleting and polluting the environment at a quicker rate than simpler systems of the past.

Responding to the contention that industrial practices deemed socially or ecologically unsound are necessary to keep up with global food demands, critics like E.F. Schumacher have called this the "poison or hunger" argument. Schumacher countered by saying, "There are highly successful farmers in many countries who obtain excellent yields without resource to such chemicals and without raising any doubts about long-term fertility and health."(1973,p.149)

Illustrative of the differences between the industrial and the regenerative paradigms is Feldman's description of the growing debate over pesticide use, one of the prominent features of industrialized

agriculture:

> On the one hand is an industry which, along with banks providing capital to farmers, promotes chemical pesticides as the one sure-fire protection against pests and poor crop yields. On the other are those who say the use of many--if not all--pesticides has **put society on a suicide course**, lowering farm productivity, creating 'superbugs' resistant to chemical controls and endangering human health for generations to come. (Feldman, 1980, p. 5)

The agricultural sciences are just beginning to grapple with the problem of developing an integrated conceptual framework to direct agricultural research and policy toward long-term sustainability in a comprehensive way. Unfortunately, even when an integrated approach to the problems of agriculture has been taken, it is usually within the restrictive framework of the dominant industrial paradigm. Until quite recently, alternative agricultural perspectives have seldom been represented in scientific journals since the parameters of the existing industrial paradigm "does not guarantee openness to new paradigms and alternative methodologies."(Lacy and Busch, 1982, p. 445)

There is a need for the perspectives and techniques of both the industrial and the regenerative paradigms to be presented within a scientific framework. This could begin to shed new light on problems facing agriculture and provide direction toward long-term sustainability.

B. Problem Statement

The central research problem of this thesis is to evaluate the industrial and regenerative paradigms in terms of the potential for promoting long-term agricultural sustainability. Critical to this evaluation is the development of an integrated conceptual model which illustrates the basic forces and interrelationships involved in agricultural development. Such a model may help illustrate the

developmental framework within which farm systems can be systematically directed toward greater ecological and social sustainability.

C. Components of the Problem.

Agriculture is a highly complex activity for which it is often difficult, if not impossible, to isolate and solve one specific problem at a time. A particular problem may have any number of physical, biological, psychological, social, economic, ecological, cultural, and other characteristics. All too often, an ill-conceived solution to one aspect of a problem has contributed to one or more new problems.

Many subjective factors are involved in deciding which segments of the infinite universe are to be studied and how they are to be studied. In this regard, Kuhn pointed out that, "Philosophers of science have repeatedly demonstrated that more than one theoretical construction can always be placed upon a given collection of data."(1970,p.76) Since the results of particular events can be interpreted in a variety of ways, values play a critical role not only in each paradigm, but in the criteria of evaluation for long-term sustainability.

Values have been called "the hidden springs of our action and thought"(Skolimowski,1984,p.51).and "fundamental to everything we do.(Milbrath,1984,p.1) They play a central role in shaping scientific paradigms. In noting the critical role of values in scientific inquiry, Maslow pointed out that, "Science is based on human values and is itself a value system."(1954,p.6)

By analyzing various components of each paradigm within the conceptual framework of a scientific model, this study may be better able to assess the potential of each respective paradigm to promote

long-term agricultural sustainability. Primary components of the proposed integrated conceptual model include the physical, biological, psychological, social, and cultural aspects of agriculture. The model also reflects three key principles of agricultural development which have either been ignored or downplayed by conventional, industrial approaches to agriculture. These principles include entropy, life's regenerative capacity, and the dual nature of long-term development: social development and ecological conservation. Recognition of these principles is critical to the evaluation of ecological and social impacts of values and practices within the industrial and regenerative paradigms.

D. Significance of the Problem

The world has much to learn from the North American agricultural experience. The system represents a crucible of positive and negative potentialities for global agriculture. A better understanding of the systemic problems in North American agriculture and potential solutions to these problems could have a significant effect on how agriculture is practiced in North America and the rest of the world.

With the prospects of increasing pressures on the natural resource base coming from continually growing human populations with rising expectations, the long-term sustainability of agriculture has become one of the critical problems of our age. The problem goes beyond that of feeding all the world's people to one of coming up with strategies for agricultural development which begin to significantly reduce the depletion of nonrenewable resources, reduce current levels of pollution in agriculture, and provide employment opportunities for those choosing farming as their livelihood.

This study is an inquiry into the patterns of agricultural development under which peoples in the world would be able not merely to avoid destruction, but to live together relatively well in one planet for the foreseeable future. This is in keeping with the approach taken by Tonnies's in Gemeinschaft and Gesellschaft, as explained by Heberle:

> For Tonnies the end and meaning of any social order was peaceful relationships among men...Sociology should point the way to the establishment of peaceful human relationships among groups, classes, and nations. (Tonnies, 1965, p. 10)

E. Thesis Objectives

The primary objectives of this thesis are:

(1) To outline some of the major ecological and social problems being manifested in North America as a result of how agriculture is commonly practiced within the dominant industrial paradigm;

(2) To outline value-orientations of key sectors in modern industrial society which tend to encourage agricultural practices with high long-term social and ecological costs;

(3) To describe an emerging broad-based movement in North America for a more regenerative agricultural paradigm through a presentation of the values, principles, and practices common to the movement;

(4) To develop a conceptual model of agricultural development which could serve as a tool for assessing alternative agricultural futures in terms of their potential for promoting long-term sustainability.

F. Plan of the Thesis

The thesis is organized in the following manner:

In Chapter II, the basic theoretical framework of the thesis is outlined. This is accomplished through a discussion of key concepts and a review of the literature on agricultural sustainability.

In Chapter III, the research methods used to approach this study are described. The limitations of a specialized approach to a problem of this scale are discussed and the basis for an integrated approach is presented.

In Chapter IV, ecological and social impacts of industrial agriculture principles, practices, and structures in North America which are not sustainable are presented.

In Chapter V, three fundamental value-orientations of key sectors supporting the industrial paradigm are identified, discussed and critiqued as being at the root of many ecological and social problems in agriculture.

In Chapter VI, an alternative set of value-orientations common to the regenerative paradigm for agriculture are presented.

In Chapter VII, principles and practices framing the emerging regenerative agriculture paradigm are outlined.

In Chapter VIII, a conceptual model is developed to bring together the various components of the study within a scientific framework to depict agricultural development choices for the future.

In Chapter IX, conclusions and recommendations for further research are presented.

G. Assumptions

In this thesis, it is assumed that:

(1) Long-term ecological and social sustainability should be a fundamental consideration for all agricultural development strategies;

(2) The current ecological and social problems in North American agriculture warrant a major reappraisal of the premises and practices of the industrial agriculture paradigm;

(3) Entropy is a fundamental law of the physical universe which should be incorporated into the development equation in order to properly plan for long-term agricultural sustainability;

(4) Given adequate information and conceptual awareness, North American society is capable of restructuring and redirecting agricultural development to better meet the objectives of long-term ecological and social sustainability; and

(5) The current period of global food surplus provides a window of opportunity to look at and experiment with alternative strategies for agricultural development.

H. Limitations

Due to the vast and complex nature of the problem discussed in this thesis, it is not always possible to discuss each specific subject area in as much detail as may be desirable. As a result, there may be the perception of a number of gaps in the overall analysis. It is believed, however, that the far-reaching insights derived from analyzing agricultural sustainability from a broad paradigm-level perspective justify proceeding with this integrated approach.

CHAPTER II

THEORETICAL AND CONCEPTUAL ISSUES

The subject of long-term agricultural sustainability is enmeshed within a maze of diverse issues. (Douglass, 1984, p. xi; Moles and Riker, 1984, p. 261) In order to develop a coherent analysis of the subject, a unifying conceptual framework must first be outlined. The purpose of this chapter is to present and clarify the primary relationships making up this conceptual framework and to briefly review the literature on agricultural sustainability.

A. Review of Key Concepts

(1) Agricultural Sustainability

At the most basic level, **agriculture** is defined as the cultivation of fields to produce crops. A **sustainable agricultural** system goes beyond this definition to base crop yields on the permanent carrying capacity of the environment. Essentially, sustainable agriculture implies a system of food cultivation which is **environmentally sound** and **socially stable** enough to be sustained indefinitely into the future. (Moles and Riker, 1984, p. 261) In other words, a sustainable agricultural system is defined as one which does not deplete soil or people. (Jackson, Berry and Colman, 1984, p. x)

An analysis of the linguistic roots of the term **agriculture**, demonstrates there is much more implied in the term than is commonly recognized today. Rowe explained that the words **culture** and **cultivation** are derived from the Latin *cultus*, to care. *Cultus*, in turn, comes from the Sanskrit word *kwel* meaning **to dwell** with as well as **to care for**. (Rowe, 1984, p. 52) In turn, the term "**culture**" is also related to both **cultivation** and **cult**, linking the ideas of tillage and

worship. (Berry, 1977, p. 87)

This indicates that deeply embedded in our language, **agriculture** is meant to describe people dwelling on the land and caring for it in a reverent manner. If our people/land relationship is to be consistent with the intent of a food system based on "*cultus*," then farming would become more than "just another business," and become a way of living life in a more reverential way. Farming would then become an act of "**culture**" in the caring way originally intended by the word **agriculture**. Berry explained that:

> To live, to survive on the earth, to care for the soil, and to worship, all are bound at the root to the idea of a cycle. It is only by understanding the cultural complexity and largeness of the concept of agriculture that we can see the threatening diminishments implied by the term '**agribusiness**.' (1977, p. 87)

When agriculture is considered just like any other industry, as in the **industrial paradigm**, farmland can become little more than an open-air factory where inputs flow through a one-way production system resulting in the output of products and wastes. In the **regenerative paradigm**, agriculture is seen as a dynamic on-going biological cycle directed by humans in which the energies of the sun combine with the biochemistry of the soil, vegetation, and animals to produce food and fiber. In keeping with the concern for long-term sustainability, agriculture is perceived as the interaction of humans with natural systems "for the purpose of making possible the indefinite development of the potentiality of human life in community." (Freudenberger, 1984, p. 96)

The approach to agricultural sustainability used in this study assumes that the ecological and social systems in agriculture are parts of a **unified living system**. Artin described the need for such a

holistic view which recognizes the interrelationships between the environment and human institutions:

> The survival of humanity demands that the condition of the natural environment and the needs of human beings be considered as interrelated parts of the same problem. This will require profound changes in our political, economic and social structures on the one hand and our individual life-styles on the other, with the aim not only one of survival, but of survival with the maximum human fulfillment. (Artin, 1973, pp. 169-170)

As this statement reflects, social development and ecological conservation operate in the same global context. If we are to develop more sustainable agricultural systems, the paths of conservation and development must begin to move closer together and converge.

(2) Entropy's Relationship to Living Systems

Prigogine, Odum, Georgescu-Roegen, Boulding, Daly, Bookchin, Rifkin, and others have drawn attention to the critical importance of incorporating the Second Law of Thermodynamics, or **entropy**, into the way we perceive and react to the world. Entropy is the universal pattern of energy dissipation and growing disorder taking place in the physical universe. Entropy shapes many of the basic relationships through time and yet is barely recognized in most conventional agricultural analysis. (Georgescu-Roegen, 1974; Rifkin, 1980; Prigogine and Stengers, 1984)

The relationship between entropy and patterns of living systems on earth is also an under-studied factor. As fundamental as the notion of life is to everything we do, our understanding of it is surprisingly limited. Commenting on the scarcity of information on the subject of life itself, Lovelock complained:

> Data galore had been accumulated on every conceivable aspect of living species, from their outermost to their innermost parts, but in the whole vast encyclopaedia of facts the crux of the matter, life itself, was almost totally ignored. (1979, p. 3)

Prigogine, a Nobel Laureate in physics, has argued that life's relationship to entropy is a critical, yet neglected subject area related to long-term agricultural sustainability. (Prigogine and Stengers, 1984, pp. 80-82) He said:

> There is [a] question, which has plagued us for more than a century: What significance does evolution of a living being have in the world described by thermodynamics, a world of ever-increasing disorder? What is the relationship between thermodynamic time, a time headed toward equilibrium, and the time in which evolution toward increasing complexity is occurring? (1984, p. 129)

Miller's living systems theory (1978) provides some valuable concepts which can help to begin to deal with this question. His theory is based on the idea that all life has evolved from similar origins and that there are similar patterns of existence and survival at all levels of life, from simple microorganisms to complex human social systems. Much of Miller's work has involved the identification of common patterns of existence among living systems and the identification of crossover patterns between different levels of living systems.

Of critical importance to this thesis is Miller's recognition of life's unique relationship to entropy. From the perspective of the total universe, even life cannot transcend this law. But within earth's bioshpere, living systems are "**open systems**" which are able to capture and store energy from the sun and use this energy to transform materials found in the environment. Living systems have, in effect, been able to bring greater order to the planet and reduce entropy within earth's bioshpere. (Hicks, 1975, p. 1)

Instead of forever running down, living organisms have been building up more complex forms of energy from the energy they absorb. (Miller, 1979) At the same time, they have been developing **more**

complex patterns of 'information,' in the form of perceptions, memories, ideas, from the input of their receptors. Miller described the *modus vivendi* of living systems:

> Scavengers of the world's stores of energy and information, they have developed unique forms of complexity, particular critical subsystems, which, working together, enable them to postpone for varying periods the destruction of their patterns by the disorganizing decay of entropy. (Miller, 1978, p. 1051)

By accepting the theory of evolution from molecules to human, scientists assume that life has undergone a series of increasingly complex transcendences of entropy in the physical universe. From the time that lifeless molecules combined to form living and regenerating cells, organic evolution has been nothing less than an endless series of transcendences of entropy.

Though living systems are in constant flux, they are able to maintain intricate patterns of stability. Rather than simply reacting passively, living systems are able to actively adapt the environment to particular needs. They are able to learn from experience and construct systems of knowledge out of the chaos of sensations impinging on them. These systems of knowledge help frame an evolving pattern of preferred behaviors which are, in effect, **a conventionalization of survival habits.**

Problems arise within living systems when conventionalized survival habits do not keep pace with changing circumstances. North American agriculture, for example, has conventionalized values and practices in response to a short-term perspective of economic survival. By consuming the fossil fuels and topsoil built up by life over hundreds of millions of years, these practices consume the ecological capital which is the basis of life-sustaining capacity for future

generations.

Miller explained that more sophisticated living systems have the potential of moving beyond conventionalized survival habits and developing "emergent processes directed toward goals."(1978,p.1051) By Miller's definition of living systems, North American agriculture is a large, complex living system which could be redesigned to help resist and postpone entropy and, in turn, promote long-term sustainability.

With the relatively recent emergence of modern culture's unprecedented powers of learning and communication, there is the potential for improving the capacity for collective survival and increasingly unified progress in the evolution of life. We have a choice not to continue depleting natural resources and adding to the pollution responsible for such global phenomena as the **Greenhouse Effect**. We can give added meaning to our lives, in an evolutionary sense, by striving to enhance the health and life-sustaining capacity of living systems on earth, especially in agriculture.

(3) Ecology

Ecology has been defined as a study of "the relationships between organisms and the larger systems of which they are part."(Rowe,1984, pp.52-53) In analyzing the history of the science of ecology, Worster demonstrated that ecology has been largely shaped by the values of those defining the term. He explained that, "Every generation... writes its own description of the natural order, which generally reveals as much about human society and its changing concerns as it does about nature."(1977,p.292)

In the **industrial paradigm**, the science of ecology is shaped by the language and models of industry and economics. Worster noted that,

"to a great extent, ecology today has become 'bio-economics': a cognate, or perhaps even subordinate, division of economics." (1977, p. 292) In this view of ecology, there are methodological problems in adequately measuring the value of ecosystems or the cost of current depletion or pollution for future generations.

Moreover, when agriculture is treated like an industry, a process of reification tends to take place. In other words, living systems tend to be treated as material objects and as unconnected factors of production, detached from their relational basis of existence. This contrasts with the regenerative viewpoint, in which the relational basis of the living systems making up agriculture is of critical importance.

(a) Community--Advocates of a **regenerative agriculture** seek to broaden the industrial view of ecology to make it more in keeping with the concept of community. From this perspective, **community** becomes "a word that refers not only to human community but to the whole community of created life and the essentials for the sustenance of all of this life." (Freudenberger, 1984, pp. 96-97) Bookchin expanded upon this notion of ecology, explaining that sustainable agriculture:

> ...seeks to restore humanity's sense of community: first, by giving full recognition to the soil as an ecosystem, a biotic community; and second, by viewing agriculture as the activity of a natural human community, a rural society and culture. (Bookchin in Merrill, 1976, p. 8)

Besides the practical survival value of viewing ecology as community, this approach can also be defended on moral grounds. Morally, it is in keeping with the teachings of great philosophers and prophets throughout history who have taught that what Albert Schweitzer called **"reverence for life"** is the most important attribute of human

beings. Because of a dominant position in the world, humans can determine what happens to all other forms of life. Along with the power to transform the world, humans also have moral responsibilities in the evolutionary process to ensure the health of life on the planet. (See Lovelock, 1979)

(b) The Gaia Hypothesis--Gaia is the Greek concept of the unity of life which has been held, usually under different names, by diverse and unconnected cultures throughout history. Lovelock's Gaia Hypothesis looks at the total community of all life on earth as one living system.

Lovelock first conceived his hypothesis while working on the U.S. space program as an engineer at Jet Propulsion Labs. When presented with the problem of how the U.S. space probe could detect life on Mars, his initial response was that, "I'd look for an entropy reduction, since this must be a general characteristic of all forms of life." The idea of looking for a reduction or reversal of entropy as a sign of life eventually evolved into the Gaia Hypothesis. (Lovelock, 1979, pp. 2-3)

In his 15 years of research across the boundaries of the sciences, Lovelock found that the Earth's biosphere, atmosphere, oceans, and soil form a complex whole, "the totality constituting a feedback or cybernetic system which seeks an optimal physical and chemical environment for life on this planet." (Lovelock, 1979, p. 11) Life on earth, according to this hypothesis, is a homeostatic system in which there is a maintenance of relatively constant conditions by active control.

Though Gaia may have self-healing systems, there are limits to the tolerance of agricultural abuse. Lovelock argued that current

agricultural practices are so destructive that the only thing saving the earth's life- support system is the fact that only about a third of the Earth's surface is land. He suggested that, "This may be why the biosphere has been able to contend with the radical transformations wrought by agriculture and animal husbandry..."(Lovelock, 1979, p. 106)

It is important to establish that the cybernetic self-regulating process of setting a goal and striving to reach it is a universal characteristic of living systems. In this regard, Lovelock acknowledged that:

> One of the most characteristic properties of all living organisms, from the smallest to the largest, is their capacity to develop, operate, and maintain systems which set a goal and then strive to achieve it through the cybernetic process of trial and error. (1979, p. 49)

This universal cybernetic process of living systems is defined as a "self-regulating process of communication and control in living organisms" which "steer an optimum course through changing conditions towards a predetermined goal."(Lovelock, 1979, p. 48) How might North American society establish a cybernetic process by which to "steer an optimum course" toward the goal of greater sustainability in agriculture?

(4) Entopic Analysis

North American agriculture, like other multi-level living systems, may be capable of resisting or postponing entropy by adapting to changing circumstances through **cybernetic self-correcting processes**. Entopic analysis is being suggested in this thesis as a cybernetic process for "steering an optimum course" toward a more ecologically benign and socially vibrant agriculture.

The root of the word, **"entopia,"** was coined by the Greek architect

and planner Doxiadis to signify **an achievable ideal**. (Doxiadis, 1977, p. 14) Whereas "utopia" is derived from the Greek "*u topos*," or "no place," and tends to connote an unreachable ideal, "*en topos*" is Greek for "in place" and represents an ideal which is based on what can reasonably be hoped for based on past experiences as well as new scientific findings.

Entopic analysis refers to a goal-setting process by which modern industrial society might begin to set and strive toward the goal of long-term ecological and social sustainability in agriculture. It is similar to what Rowe spoke of when he described the ideal of human ecology as being:

> ...the study of the right relationships between people and the living land. From this viewpoint, the primary crop of agriculture is a caring people, for only caring people can have a right relationship, a sustaining relationship with the land. (Rowe, 1984, pp. 52-53)

In an age when communication systems can bring people together almost instantly with a vast wealth of information on how the world works, **entopic analysis** is based on the notion that the current technological determinism "must be replaced with conscious, voluntary, intelligent compromises designed to make life richer, more beautiful, more satisfying both in the present and the future." (Borsodi, 1929, p. 444)

Healthy agricultural systems, like healthy ecosystems, need self-correcting elements which provide for balance within the system. Ethical goals for agriculture, such as sustainability, stewardship, justice and participation have built-in limits which provide for balance in the system.

The **regenerative paradigm** is concerned with maintaining and

enhancing healthy balances at all levels of agricultural systems. Berry outlined this notion, observing that:

> The real problem of food production occurs within a complex, mutually influential relationship of soil, plants, animals, and people. A real solution to that problem will therefore be ecologically, agriculturally, and culturally healthful. (1981, p. 137)

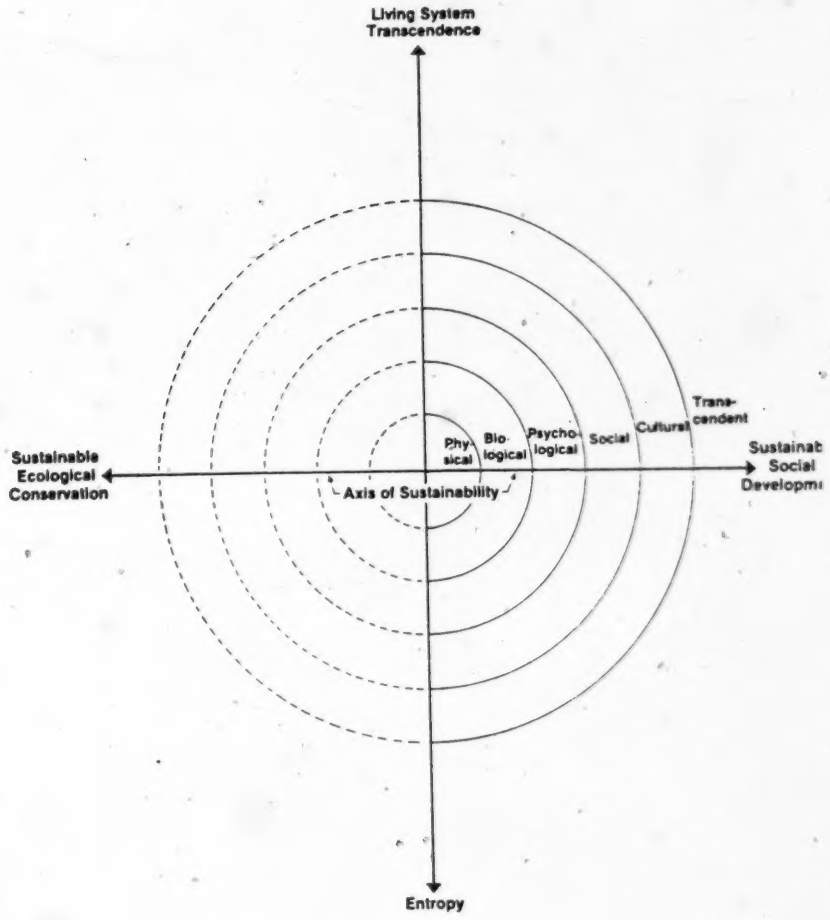
This is the type of multi-level solution being sought through the development of entopic analysis.

(5) Building a Conceptual Model

Having outlined a series of relationships critical to agricultural sustainability, an integrated conceptual model can be designed and presented to help visualize the fundamental causal links in agricultural development. This model provides a conceptual framework upon which paths toward greater sustainability can be better understood and striven towards.

The model, depicted in **Figure 1** below, illustrates three of the fundamental relationships inherent in agricultural development. First, the expanding concentric circles represent life's evolution toward greater complexity and integration. Second, the horizontal axis reflects the two- sided nature of agricultural sustainability, social development and ecological conservation. Third, the vertical axis represents the opposing forces of the physical decay of entropy and the regenerative potential of living systems.

Figure 1. Model Depicting Three Fundamental Relationships of Agricultural Development



B. Overview of the Literature

A great deal has been written about agricultural sustainability in recent years. Most of the literature has focused on ecological issues, while a smaller group of writings has dealt primarily with social issues. The type of integrated approach featured in this thesis is even more rare. A brief overview of some of the most important books

and articles may provide useful background information to interested readers.

(1) Ecological Sustainability

There have been numerous reports on the problem of soil erosion in the United States and Canada. Among the most noteworthy are the National Agricultural Lands Study(1980), cosponsored the United States Department Of Agriculture and the Council on Environmental Quality; Soil at Risk: Canada's Eroding Future(1984), presented by the Standing Committee on Agriculture, Fisheries, and Forestry to the Senate of Canada; and Sustainability of Farmed Lands: Current Trends and Thinking (1985), by C.F. Bentley, former Dean of Agriculture at the University of Alberta, and L.A. Leskiw. These and other reports point to the severity of the soil degradation problem in North America.

Looking at the wider ecological effects of modern industrial agriculture, including pollution and resource depletion, are books like Green's Eating Oil: Energy Uses in Food Production (1978); Sanderson's Agriculture and the Environment(1981); Regional Environmental Consequences of Increases in Agricultural Production in the United States(1982), by Clifton and others; and Food for Tomorrow?(1984), by Freudenberger. Useful articles include Pimentel's "Land Degradation: Effects on Food and Energy Resources"(1976) and McGill's "Soil Conservation Requires Integrated Agricultural Systems"(1985). The latter article is written by the head of the Soils Department at the University of Alberta and is well worth reading for its holistic approach which relates high rates of soil erosion to declining economic productivity in agriculture.

In the area of positive ecological models for agriculture, there

have been several excellent books on successful alternative agricultural technologies including Howard's The Soil and Health(1947), Fukuoka's One Straw Revolution(1978), Wolf's Organic Farming: Yesterday's and Tomorrow's Agriculture(1977), and Jackson's New Roots for Agriculture(1980). A book which describes the reclamation of badly degraded soil is Bromfield's Pleasant Valley. For a holistic, ecological approach to the planning and design of more ecologically sustainable human environments, "Redesigning the Food System for Sustainability"(1985), by Hill, and Bioshelters, Ocean Arks, City Farming: Ecology as the Basis of Design(1984), by Nancy and John Todd are excellent guides.

(2) Social Sustainability

In the subject area of the social consequences of modern industrial agriculture, valuable contributions are made by two U.S. government reports: the U.S. Department of Agriculture's Structure Issues of American Agriculture(1979) and the Office of Technology Assessment's Technology, Public Policy, and the Changing Structure of American Agriculture(1986).

Other useful books and articles on the subject of the social effects of agricultural industrialization include The Social Consequences and Challenges of New Agricultural Technologies(1984), edited by Berardi and Geisler; Hard Tomatoes, Hard Times(1978), Hightower's critique of the U.S. land grant college system; Food First(1982), Lappe and Collin's analysis of the international food system; "The Implications of Changing Farm Structure in Nebraska Communities"(1984), by Swanson; and numerous articles by Buttel, a rural sociologist.

An analysis of some of the health effects of industrial agriculture practices can be found in a report from the Center for Rural Affairs entitled It's Not All Sunshine and Fresh Air: Chronic Health Effects of Modern Farming Practices(1984), by the Center for Rural Affairs or in a variety of articles by Feldman, an expert on the health effects of agrichemicals. In a subject related to human health, The Denial of Death(1973) by Becker provides some interesting insights into the psychological roots of societal behavior patterns that apply to the situation in modern industrial agriculture.

On social-philosophical issues, Fromm's The Sane Society(1955) and To Have or to Be(1976) provide perspectives which challenge the values of modern industrial society. Analysis of the resource limits of continued economic growth is provided in such books as Anderson's The Sociology of Survival: Social Problems of Growth(1976), Johnson's Muddling Toward Frugality(1978), Dasgupta's Toward to a New Approach to Development(1980), and Rifkin's Entropy(1980).

Useful books on the subject of guiding communities and societies toward becoming more sustainable social systems include Blasi's The Communal Future: The Kibbutz and the Utopian Dilemma(1980), L. Brown's Building a Sustainable Society(1981), and Meisner's Marxism, Maoism and Utopianism(1982).

(3) Integrated Perspectives on Sustainability

For collections of essays which provide wide-ranging views on the subject of agricultural sustainability, several books stand out. Among these are Agricultural Sustainability in a Changing World Order(1984), edited by Douglass; Meeting the Expectations of the Land: Essays in Sustainable Agriculture and Stewardship(1984), edited by Jackson,

Berry, and Colman; Radical Agriculture(1976), edited by Richard Merrill; and Farms in Transition: Interdisciplinary Perspectives on Farm Structure(1983), edited by Brewster, Rasmussen, and Youngberg.

A number of books relate to the subject of agricultural sustainability in peripheral, yet important ways. To better understand the nature of the physical world and the special nature of living systems, Lovelock's Gaia: A New Look at Life on Earth(1979) and Miller's Living Systems(1978) are useful. On the other hand, historical perspectives on the problems of agriculture can be found in The Promise of the Coming Dark Age(1976), by L.S. Stavrianos; The Wealth of Some Nations(1977), by Caldwell; and This Ugly Civilization(1929), by Borsodi.

Two especially important books describing alternative economic perspectives for industrial society were both published in 1973. With the publication of Small is Beautiful, Schumacher introduced the idea of appropriate technology to the general public. In the same year, Daly published Toward a Steady-State Economy. Both books recognized the limits of growth inherent in the reality of finite resources and the threat to the environment of increasing levels of pollution.

Finally, a number of books and articles look at desirable alternative futures for agriculture and rural development. These include Resettling America: Energy, Ecology, and Community(1981), edited by Coates; Eco- Philosophy: Designing New Tactics for Living(1981), by Skolimowski; "A Geobased National Agricultural Policy for Rural Community Enhancement, Environmental Vitality, and Income Stabilization"(1984) by Hayden; and "Redesigning the Food System for Sustainability,"(1985) by Hill.

Besides the resources already identified in this section, articles appear almost daily in the local newspapers describing different aspects of the growing crisis in agriculture. These articles, however, tend to only identify symptoms of what is really a systemic problem in modern industrial society. This thesis is an attempt to identify the common roots of these crises and to present alternative paths to greater long-term ecological and social sustainability.

CHAPTER III

RESEARCH METHODS

A. Research Purpose

The purpose of this study is to develop scientific methods to evaluate the potential of industrial and regenerative paradigms to promote long-term agricultural sustainability. The fundamental concepts and relationships outlined in Chapter II provide a conceptual framework within which this evaluation of practices and values of each paradigm can be undertaken. This chapter explains the research methods used to conduct the evaluation.

B. Special Methodological Problems

(1) Overspecialization in the Industrial Paradigm

Within the industrial paradigm, the agricultural sciences tend to be highly specialized and deal with specific social and ecological problems in isolation from each other. As a result, problems in agriculture tend to be perceived and approached on a piecemeal basis.

While specialized methodologies have contributed to vast knowledge about the minutest details of agricultural development, there is still a great need for integrated methodologies which would help promote a holistic understanding of the contextual role of this diverse and plentiful data. (Skolimowski, 1981, p. 14) Both the problems and the solutions relating to long-term agricultural sustainability are complex and multi-faceted. Just as the problems of the depletion of natural resources, pollution, and rapidly increasing populations are interrelated, so, too, are the values and practices which are likely to contribute to long-term sustainability. (Douglass, 1984, p. 203) Without a contextual understanding based on fundamental relationships,

insignificant fragments of information may be magnified out of proportion while more essential information is lost in obscurity. (Becker, 1973)

(2) Difficulty Identifying Societal Values

Despite the central role of value systems in directing agricultural development, they remain a greatly under-studied phenomenon. Because they are not clearly identifiable and quantifiable, values are difficult to analyze and have a hidden, almost mysterious nature about them. Lockeretz recognized the ethereal quality of "values" when he observed that:

> ...the present generation's obligation, if any, to conserve limited resources like energy and water for future generations is tied to fundamental values and principles that transcend the usual limits of agricultural economics or any of the other disciplines that deal with agriculture. (Lockeretz, 1984, p. 86)

To compound the difficulties associated with getting a handle on societal values, it should be recognized that there is a strong reluctance to analyze the basic assumptions and values which steer agricultural development in North America. (Etzioni-Halevy, 1981, p. 300) As Berry argued, "There is nothing more characteristic of modern agricultural research than its divorcement from the sense of consequences and from all issues of value." (1977, p. 148) Rather than asking whether the whole system is arranged illogically and based on faulty value assumptions, individuals make adjustments and adapt to the mounting pressures. (Rodale and Dybdahl, 1985, p. 7, 9, 10)

Much of this resistance to questions regarding the underlying assumptions and values of industrial agriculture comes from those with heavy personal investments, in terms of experience, education, and income, in things remaining as they are. (Johnson, 1978, p. 232) Hill

noted a functional connection between this reluctance to examine the assumptions and values underlying agricultural development and the failure to deal effectively with the causes of decline in agricultural environments, family farms, rural communities, and society in general due to changes in agriculture. (Hill, 1985, p. 33)

(3) Methodological Individualism Versus Collectivism

Within the **industrial paradigm**, a process of methodological individualism is dominant. This process is based on the reductionist assumption that the best way to study science is to study specific individual subprocesses. Secondary and collective impacts of these particular subprocesses tend to be considered external to the subprocesses themselves.

The approach to science within the **regenerative paradigm** is to recognize these subprocesses as having differing impacts within different contexts. These potential impacts are considered integral to the subprocesses themselves and can be analyzed within the framework of the long-term development relationships identified in Chapter II.

C. Methods of Sociological Analysis

(1) An Integrated, Interdisciplinary Approach

An integrated, interdisciplinary approach is used to link the various levels of agricultural development in an attempt to recognize the root of problems and to identify potential systemic solutions to sustainability problems. This is in keeping with a report to the United Nations on the ecology of human communities in which Boyden argued:

> A new integrative approach is called for--one which ensures that, whatever the nature of the problem, or whatever the nature of the proposed plan, it will be examined and assessed in terms of all its aspects and all its implications. (Boyden, 1979, p. 67)

Both Borlaug (1986) and Murri (1986) have called for integrated approaches to agricultural analysis, but have tended to take the existing industrial system and trends for granted and have developed patterns of response which perpetuate the existing sets of relations. A truly comprehensive integrated analysis of agricultural sustainability requires an awareness of the "broader economic, institutional and structural aspects of agriculture. Indeed, it goes beyond the bounds of agriculture itself."(Lockeretz, 1984, p. 86)

This study goes beyond the boundaries of the assumptions underlying the dominant industrial paradigm to incorporate those underlying the regenerative paradigm. It presents critical assessments of North American agriculture from a wide range of paradigm-level perspectives. Ecological, sociological, agricultural, economic, philosophic, psychological, and other viewpoints are integrated in order to help recognize valuable crossover concepts which may have been hidden from view by over-specialization.

(2) Method of Value Identification

There are two basic methods for determining current value distributions. (Enk and Hornick, 1983, p. 61) The first involves surveying people about their values. The basic limitation of such a survey is that it often elicits only what people think they believe or what they are prepared to say. Moreover, it does not necessarily explain what motivates their behavior. (Enk and Hornick, 1983)

The second method of determining value distribution is to infer values from peoples' behavior. This entails observing behaviors and inferring what values brought about those behaviors. This method is also problematic because the values of the observer can unconsciously

affect the observations. (Enk and Hornick, 1983, p. 61)

This study utilizes the second method of value identification and incorporates a process of what W. Samuels called methodological collectivism to help evaluate the likely impact of certain value-based behavior patterns of long-term sustainability. Fromm and Maslow similarly used the perspective of universal values to evaluate the accepted values of society and judge the mental health of society at large. They argued that adjusting to a system that is fundamentally flawed "may be less healthy" than being maladjusted on the basis of universal values. (Fromm, 1955; Maslow, 1954, p. 127)

This study identifies human values in North American society which tend to contribute to systemic breakdown in the long-term. It also outlines a series of value orientations designed to enhance long-term sustainability. Henderson sees this process of outlining alternative futures as being "part of a living orchestration, generating larger patterns, out of which grow new paradigms of knowledge, policy, and personal behavior." (1981, p. 5)

(3) Prescriptive Approach

A prescriptive approach is taken in an attempt to direct agricultural development toward greater sustainability. Schmitz and Seckler defended a prescriptive approach, arguing that, "it is the social scientist's task to devise a variety of institutional structures appropriate to the problems with which society is afflicted." (1984, p. 115) Similarly, Cernea called for rural sociologists to identify problem areas and to outline solutions to those problems. He explained that:

> The calling of sociology is not only to analyze and explain, but also to help transform the status quo. Findings about the past

> should be distilled into methodologies for further action. Diagnoses should be followed by proposals for problem solving. (1984, p. 6)

This thesis describes ecological and social patterns resulting from agricultural industrialization and later presents a series of prescriptive principles and practices designed to help build upon the inherently renewable potential of healthy living systems in agriculture. In the process of dealing with these issues from diverse perspectives, it is hoped that human understanding is advanced and the potential for long-term survival enhanced. Entopic analysis is briefly outlined as a multi-level prescriptive tool for steering an optimum course toward long-term health and sustainability.

D. The Nature and Sources of Data Used

Data for this study were collected through an extensive library search at the University of Alberta, Princeton University, and through interviews conducted by the author at five different private non-profit institutes in the U.S. involved in agricultural sustainability research. The staff interviews took place in November 1986 at the International Alliance for Sustainable Agriculture in Minneapolis, Minnesota; The Land Institute in Salina, Kansas; The Center for Rural Affairs in Walthill, Nebraska; The Small Farms Resources Project in Hartington, Nebraska; and The Land Stewardship Project in Stillwater, Minnesota. Resource materials were also collected from a visit to the library at Rodale Press, in Emmaus, Pennsylvania. A wide variety of critical perspectives on industrial and regenerative strategies for agriculture were studied from these sources in order to gather as far-reaching an analysis of agricultural sustainability as possible.

Hopefully, an appropriate level of caution has been observed in

collecting data outside the author's primary area of study. It is well to heed Cernea's advice that, "Sociologists should become able to be more prescriptive, without discounting the cautiousness dictated by their limited knowledge."(Cernea,1984,p.5) A concerted effort has been made to eliminate unsubstantiated editorializing while still getting across the points that need to be made. A wide range of experts in the ecological and social sciences have been drawn upon to support arguments with quantitative data where available.

In an informal survey at the five sustainable agriculture research institutes, this author noted that the vast majority of professionals identified Wendell Berry as the author leaving the greatest impression in terms of an integrated perspective on agricultural sustainability. Berry is something of a Renaissance man who works as a farmer, as a professor at the University of Kentucky, and as a writer of highly acclaimed poetry, fiction, and nonfiction. Two of his popular works of nonfiction are The Unsettling of America(1977) and The Gift of Good Land(1981). These two books are full of valuable technical information on agriculture and are written with an eloquence and depth of understanding that make them likely to continue to influence people well into the future.

E. Limitations of Data Sources

Since most of the scholarly agricultural journals tend to accept and defend the basic assumptions of the industrial paradigm, there is a lack of balance in much of the conventional scientific literature. Most of the mainstream scientific journals commonly adopt the industrial paradigm perspective and have been slow to admit there is a problem with the long-term sustainability of North American

agriculture.

Much of the literature on agricultural sustainability, on the other hand, assumes there are problems with the way agriculture is commonly practiced. In order to get more information on agricultural sustainability, it was necessary to look outside standard sources of scientific literature to a wide variety of alternative perspectives presented in books, newspapers, and journals.

Through several draft stages, this thesis was criticized for depending too much on agricultural "outsiders" such as Berry, Borsodi, Jackson, Henderson, and Rifkin. A concerted effort has been made to eliminate or replace references to these theoreticians where possible. Gradually, however, these and other long-time critics are being recognized and studied by establishment scientists.

CHAPTER IV

ECOLOGICAL AND SOCIAL IMPACTS OF INDUSTRIALIZED AGRICULTURE

The industrialization of North American agriculture has had a profound impact on the structure of agriculture, that is, in "the size and number of farms, the amount of capital and labor employed per farm and in the industry, the degree of specialization, and related parameters." (Heady, 1983, p. 24) While these changes have generally been regarded positively, they are also being linked to problems of ecological degradation, agricultural pollution, and the degradation of social systems.

A. Ecological Degradation

The severity of ecological problems arising from industrial agriculture in North America are not widely understood, even by the environmental movement, which Lovelock said:

> ...tends to attack quite visciously such inappropriate targets as the flurocarbon industry and fox-hunting, while turning a blind eye to the potentially more serious problems posed by most methods of agriculture. (1979, pp. 144-145)

Ecological problems which have tended to arise as a result of the structure and practices of industrial agriculture in North America include: (1) soil degradation; (2) water depletion and contamination; (3) fossil fuel depletion; and (4) the destruction of biological resources.

(1) Soil Degradation

The agricultural transition from a biological system based on the rotation of crops to a monocultural system based on massive inputs of chemicals has resulted in increased short-term yields, but also in increased rates of soil erosion and depletion. (Douglass, 1984, p. 39) The

diverse dimensions of the soil degradation problem in North America include total erosion, the erosion per acre, the loss of organic matter and other soil nutrients, the decline of soil structure, salinization, and soil degradation from heavy machinery.

(a) Total erosion--As early as 1976, Pimentel's group estimated that "we have lost one-third of the topsoil from U.S. cropland in use today."(1976, p. 150) In another measure of soil erosion, the Council for Agricultural Science and Technology reported in 1975 that a "third of all U.S. cropland was suffering soil losses too great to be sustained without a gradual but ultimately disastrous decline in productivity."(Brown, 1981, p. 24)

Whereas an estimated three billion tons of soil was blown away annually in the U.S. during the dust bowl years of the 1930s, a USDA report estimated that we are currently losing at least four billion tons of soil a year by sheet and rill erosion alone. (Douglass, 1984, pp. 11-12) Water erosion removes about 2 billion tons of U.S. topsoil annually -- just over a billion tons more than is formed each year. (USDA, 1980) If one assumes an average topsoil depth of 8 inches and each acre-inch of soil weighs 160 tons, the net annual loss of a billion tons is equivalent to the loss of 781,000 acres of cropland per year. (Brown, 1984, p. 39)

Specific areas of the U.S. are especially hard hit by erosion. Iowa, one of the most fertile areas in the world, is losing 260 million tons of soil from cropland each year. (L.R. Brown, 1984, p. 39) At this rate, about two bushels of Iowa topsoil are lost for each bushel of corn grown. (Berry, 1977, p. 9)

(b) Erosion per acre--The USDA has assigned a soil loss tolerance

(T) for most cultivated soils based on the quality and depth of the soil. These T-values, which never exceed 5 tons per acre per year, are the maximum rates of soil loss that will permit sustained crop productivity. When the national soil survey was conducted in accordance with the Soil and Water Resources Conservation Act of 1977, it was found that an average of 14.9 tons of topsoil per acre of cropland was being eroded annually in Texas, 14.1 tons in Tennessee, 11.4 tons in Missouri, 10.9 tons in Mississippi, 9.9 tons in Iowa, and 8.9 tons in Colorado. (USDA, 1980) Nationally, erosion exceeded the T-value of soils on more than 112 million cropland acres, even excluding soil losses caused by wind and gully erosion. (Larson, 1984, p. 67).

The U.S. Government Accounting Office did a study of soil loss on 283 randomly selected farms located in the Great Plains, Corn Belt, and Pacific Northwest regions. Of the farms evaluated, 84% were losing soil in excess of the five tons per acre per year. (Freudenberger, 1984, p. 35-36)

Results of The National Agricultural Lands Survey Report demonstrated that high rates of soil erosion are less an inevitable outcome of farming than a result of short-sighted practices. For example, a 14-year study of erosion rates by the Missouri Agricultural Experiment Station documented that land planted continuously to monoculture corn lost 19.7 tons of topsoil per acre annually, whereas similar land planted in a corn-wheat-clover rotation lost only 2.7 tons per acre annually. (NALS, 1980)

(c) Loss of organic matter and soil nutrients--Eroded sediment usually contains about twice the concentration vital organic matter and

nutrients such as nitrogen, phosphorus, and potassium as the surface soil from which it originated. Millions of bacteria, fungi, algae, protozoa, and small invertebrates such as worms and arthropods are also contained in every ounce of fertile soil. While it takes about 500 years to create an inch of topsoil, Iowa farms are now losing an inch of soil every 15 years and some farms in Tennessee are losing an inch of soil every three years. The average acre of Corn Belt cropland is losing about 10 tons of soil annually, resulting in the loss of about 40 pounds of nitrogen, 20 pounds of phosphorus, 400 pounds of potassium, and 460 pounds of organic matter annually. (Larson, 1984, pp. 67-68) Similarly, a report by the Environment Council of Alberta estimated that when one inch of Dark Brown topsoil is removed, 529 pounds of nitrogen, 154 pounds of phosphorus, and 4.3 tons of organic matter per acre is lost. (Sanderson, 1981, p. 11)

(d) Declining soil structure--As the depth of topsoil shrinks and the organic fraction declines, other changes begin to take place in the structure of the soil. Among the soil structure problems commonly identified are oxidation of the humus, loss of soil tilth, compaction by heavy farm machinery, formation of gullies by erosion which may reduce field size, accumulation of salts, reduced root depth, acid buildup, waterlogging, poisoning from toxic substances, and loss of water storage capacity in the soil which leads, in turn, to lowered drought resistance and higher susceptibility to erosion.

(e) Soil salinization--The application of synthetic chemicals to the soil and intensive irrigation practices have contributed to a growing problem of soil salinity. It is estimated that salinization affects 2.2 million hectares of dryland and over 100,000 hectares of

irrigated land on the Canadian prairies. In 1985, an estimated 250,000 tonnes of lime was needed in Alberta and northeastern British Columbia to offset the yeild-depressing effects of soil acidity. The acreage of dryland affected by salinization may be increasing in some areas at a rate of 10 percent per year. (Vander Pluym in ASSWA, 1981).

(f) Soil degradation from mechanization--Soil conservation methods such as terracing, contour plowing, and hedgerows are being eliminated to accommodate larger farm machinery, adding to the soil erosion potential. This is true in southern Alberta where the practice of strip farming to reduce wind erosion is disappearing. To accommodate larger machinery, field sizes have been increased by removing windbreaks such as woodlots and shelterbelts, or by draining sloughs. (Sanderson, 1981, pp. 12-13)

Besides these intentional changes of the land, there are also unintentional degradations brought about by the compaction of the soil under heavy farm equipment. The more the soil becomes compacted, the heavier the tillage equipment needed to plow the land. (Berardi and Geisler, 1984, p. 15) As larger, heavier equipment compacts the soil, its water-retention capacity is reduced, fostering higher rates of water-runoff and soil erosion as well as reducing drought resistance. As the soil is compacted under heavy machinery, root growth capacity and the availability of plant nutrients are reduced. In addition, recovery from freezing conditions is slower, a fact of special significance in northern climates such as Alberta. (Freudenberger, 1984, p. 41)

(2) Depletion of Water Resources

Industrial agriculture practices have depended on large amounts of

water. Water is consumed at unsustainable rates both for irrigation and in the process of manufacturing agrichemicals.

(a) Irrigation--Total irrigated acreage in the U.S. grew from 20.5 million in 1944 to 50.7 million in 1978, raising to 12 percent the proportion of cropland which is irrigated. (Larson, 1984, pp. 74-75) In many cases, water has been pumped out of underground aquifers faster than it can be replenished. A 1981 article in *Newsweek* warned that in the U.S., "Most of the vast underground resources deposited over thousands of years have been seriously depleted in a few decades." ("The Browning of America", p. 26) If these trends continue, it is projected that more than 5.1 million acres of land in the United States will dry up and become desert in our lifetime.

A prime example of this depletion process is in the Ogallala aquifer of the central U.S. Once the largest known deposit of underground water in the world, it is estimated that over half of the total aquifer was exhausted by 1977, and virtually the rest will be gone within the next 30 to 50 years. (Freudenberger, 1984, p. 54) As a result of this rapid depletion, an estimated 3.5 million acres of land irrigated from the Ogallala formation will have to be returned to dryland farming by the year 2000 and these converted acres will produce only 60 percent of what they did under irrigation. (Larson, 1984, pp. 74-75) Other experts predict that water supplies in parts of Nebraska will become so depleted that farming may never return. ("The Browning", 1981, p. 27)

A recent U.S. Congressional study entitled The Development and Allocation of Scarce World Resources noted that, "On a national average, fresh water discharge now exceeds recharge by about

one-third."(U.S. Congress, pp. 196- 197) In another report, the USDA projects that while land in some areas will be forced out of irrigation because of inadequate water resources, irrigation in other areas will continue to increase and total irrigated acres in the U.S. will remain nearly constant through the year 2000. (Larson, 1984, pp. 74-75)

(b) Water-intensive petrochemical production--The manufacturing process for nitrate fertilizers is not only energy-intensive, but also water-intensive, requiring 130,000 gallons of water per ton. (Hicks, 1975, p. 36)

(3) Depletion of Fossil Fuels

One of the myths about industrial agriculture is that it is an energy-efficient production system. In an article for *Science* magazine, Steinhart and Steinhart observed that when efficiency is measured in terms of food calories output per energy input, the "high-energy agriculture system of the industrialized world [is] one of the least efficient in history."(1974, p. 312) This observation is based on the fact that whereas most traditional agricultural systems are energy-gaining processes, modern agribusiness is generally an energy-losing system.

The greater energy efficiency of "primitive" agriculture is documented in numerous sources. Farb, for example, asserted that a farmer with an ox and plow can usually produce about 10 calories of energy for each calorie expended. (1978, pp. 181-182) Chinese wet-rice farmers produce about 40 calories of energy for every calorie of input. (Schumacher, 1973, p. 189) Pre-industrial agricultural systems produced anywhere from 5 to 50 calories for every calorie invested. (Steinhart & Steinhart, 1974, p. 312)

With industrialized agriculture, the energy inputs are usually greater than the resulting food energy derived from the farming process. Steinhart and Steinhart explained that Western high-energy food systems consume 5 to 10 energy calories to obtain one food calorie, and argued that, "It is hundreds of times less efficient than Asian wet rice cultivation."(1974, p. 312) Margolis noted that, "For each calorie of feed energy the American farmer produces, he expends eight calories of petro-chemical energy--**clearly a suicidal ratio**." (Margolis, 1978, p. 7)

Much of the energy consumed by industrial agriculture is that required to run the farm machinery and the energy embodied in the synthetic fertilizers and pesticides required to maintain artificial agricultural environments. On the average, current agribusiness consumes the equivalent of 80 gallons of gasoline to produce an acre of corn. (Steinhart and Steinhart, 1974, p. 312)

(4) Degradation of Biological Resources

(a) Destruction of wildlife habitats--Wildlife habitats are eliminated when sloughs and swamps are drained or when woodlands are cleared for increased machinery efficiency or agricultural production.

(b) Genetic truncation--Since World War II, plant life has been genetically manipulated to be highly responsive to chemical fertilizers, and in most cases, an abundance of water. Seed companies have, in this way, become an integral part of the fossil-fuel based system of industrial agriculture. Agrichemical companies have also been buying up seed companies, gaining further control of agriculture. (Freudenberger, 1984, p. 45)

Meyers warned in The Sinking Ark that many plant species and

varieties in North America have become extinct since the vast plantings of the commercially developed coarse and fine grains of industrial agriculture systems. As similar patterns of genetic truncation spread to developing countries, local seed bases are being lost, ending a genetic continuity of many millennia and threatening further ecological decline.

(c) Evolution of more hearty pests--Studies have shown that although pesticide use has increased from 200,000 pounds in 1950 to over 1.6 billion pounds in 1976, crop losses due to pest damage have remained at about one-third of total production. (Wink, 1984, p. 14; Rifkin and Howard, 1982, p. 3) Despite the massive and expanding application of pesticides and herbicides in North American agriculture, some insect and weed problems are actually increasing. Hill explained that:

> Because of certain features in the design and management of most modern agroecosystems, particularly their lack of diversity in space and time, high incidence of stress, and obstruction of recovery mechanisms, recurrent pest outbreaks are the norm. (Hill, 1985, p. 33)

Both insect and weed pests have developed genetic resistance to chemical exterminations. In other cases, ecological vacuums introduced by the elimination of easy-to- kill pests encourage new, tougher weeds and insects, which require new, and often stronger, pesticides. (Zwerdling, 1983, p. 21) An article in the *New York Times* related that, "Insect resistance is now reported in 428 insect species and related organisms, and 30 common annual weed species are resistant to the triazine herbicides (the most commonly used)." (Feldman, 1985)

Moreover, some of the best-selling herbicides weaken major crops and make them more susceptible to insects and disease, requiring other chemical applications. In this way, farmers get caught on an expensive

chemical treadmill of dependency. Altieri, an agricultural ecologist at the University of California, explained that, "The more herbicides farmers use, the worse their crop problems get, and the more pesticides they use."(Zwerdling, 1983, p. 21)

B. Agricultural Pollution

A USDA report acknowledged that, "The nature of modern- day farming makes agriculture potentially a major polluter."(USDA, 1979, p. 7) Despite a shortage of funds and logistical problems, the National Cancer Institute is trying to isolate causal factors for the inordinately high rate of cancer in farming. ("Cancer and Farming", 1984, p. 4) Since 1963, for example, more than 15 studies have documented an elevated risk among farmers of getting leukemia, a form of cancer affecting the blood system. Higher rates of cancer of the liver, kidney, lip, prostate, stomach, skin, lung and other cancers have also been statically linked to farming in the U.S. and other countries. ("Cancer and Farming", 1984, p. 3) In Iowa, for example, farmers are 48% more likely to die from multiple myeloma (a cancer affecting the bone and bone marrow) than the general population. Farmers in a six county area along the Platte River in central Nebraska are nearly twice as likely to die from leukemia than the general population. ("Cancer and Farming", p. 3) In another study of three Illinois counties from 1973 through 1980, cancer deaths were up to five times higher among farmers. (Study, 1986, p. 12)

The drinking water supply is a leading suspect for the inordinately high rates of cancer among the farm population. The threat is especially great where wells are shallow and farm chemicals are able to percolate into the groundwater and contaminate drinking

supplies. The Nebraska Water Conservation Council monitors water contamination in Nebraska and reported that 10 percent of 451 randomly selected wells in central Nebraska were contaminated with detectable levels of pesticides or by nitrates in excess of health standards. Another report indicated that about 40 Nebraska communities exceed the safe drinking standards for nitrates and the number of communities is growing. (Water Watch, 1984, pp. 1-4)

Agriculture is the major source of water pollution appearing in approximately 95 percent of the hydrologic river basins in the U.S. (USDA, 1979, p. 195) A study released by the Agricultural Economics Department at the University of Georgia indicated that agriculture contributes more than half of all sediment loadings and 360 times the sediment discharged by municipal and industrial point sources after treatment. (Clifton, et al., 1982, p. 8) In a Canadian study, Tolba argued, moreover, that:

> ...of all the activities of man that influence the quality of groundwater, agriculture is probably the most important, as a diffuse source of pollution from fertilizers, pesticides, and animal wastes... (Tolba in Sanderson, 1981, p. 18)

The most commonly identified source of the farm health problems is the widespread use of a multitude of agrichemicals. A USDA report indicated that:

> A growing body of scientific evidence is linking the use of agricultural chemicals, food additives, and animal drugs to human health conditions. Many are being isolated as cancer causing compounds... In many cases, it seems, we have been paying hidden costs for the dramatic increases in agricultural productivity. (USDA, 1979, p. 264)

Environmental damage caused by the increasing use of herbicides, pesticides, and chemical fertilizers has been estimated at $839 million annually, not including the cost of any harm done to the health of people. (Rodale and Dybdahl, 1985, p. 9) Many would argue, however, that

no price tag can be put on the environmental costs inherent in the destruction of wildlife habitats and the contamination of soil, water, and air.

(1) Pesticide Pollution

Pesticides have been developed as a means of enhancing agricultural productivity through the control of insects, weeds, and plant diseases. Aggressive advertising campaigns by the chemical industry have contributed to the expansion of pesticide usage. There are now over 225,000 tons of 1,000 major pesticides sold annually for agricultural, forestry, food storage, horticultural, and household use. (Freudenberger, 1984, p. 22) The United States is using about 6.25 pounds of pesticide per capita annually to grow its crops. (Rodale and Dybdahl, 1985, p. 9)

Evidence of the adverse effects of pesticides on the integrity of natural ecosystems and on public health has been accumulating. (Douglass, 1984, pp. 12-13) Growing public concern has been backed by two reports by the U.S. General Accounting Office on pesticides in foods: Pesticides: Need to Enhance FDA's Ability to Protect the Public From Illegal Residues(1986) and Pesticides: Better Sampling and Enforcement Needed on Imported Food(1986).

In a national survey of pesticide poisonings requiring hospitalization, the U.S. EPA's Office of Pesticide Programs (OPP) found that farmers and farmworkers were twice as likely as any other occupational group to require hospitalization. While there was a 22 percent increase among farmworkers and a 32 percent increase among farmers in hospitalization cases in the period 1974-1976 over the period of 1971-1973, poisonings among other groups remained

unchanged. (Feldman, 1980, p. 5)

The OPP was able to document 3,000 pesticide poisonings requiring hospitalization in the early 1970s and in another study, the Medical University of South Carolina found that on the average, physicians treat 15 cases of pesticide poisoning for every case requiring hospitalization. Combining the results of these two studies, it can be estimated that 45,000 people each year are poisoned by pesticides. (Feldman, 1980, p. 5)

This kind of estimating process is required because there is no federal law requiring the reporting of pesticide poisonings despite the fact that each year 5 million farmworkers are exposed to toxic pesticides and an estimated 21,400 are poisoned, some fatally. (Feldman, 1980, p. 6) There are also related health hazards faced by workers in chemical plants, farmers, farmworkers, and the general public. The lack of reporting procedures contributes to the potential for outbreaks of major health problems.

Though farmers and farmworkers are the most directly affected by pesticide poisonings, there are also health problems for the general population. Pesticides often "leach through the soil and can potentially harm animal life, and humans, in certain circumstances." (USDA, 1979, p. 7)

The general use of DDT was banned by the U.S. Environmental Protection Agency in 1972. The pesticide industry adapted by replacing "**organochlorines**" like DDT, which decay slowly in the environment, with "**organophosphates**" and "**carbamates**" which decay more rapidly but are more toxic. These chemical insecticides also pose health risks to people as their effects on humans is similar to that on insects, though

on a different scale. Feldman explained the effects of pesticide poisonings on people:

> Insecticides, which can be inhaled or absorbed through the skin, retard the body's ability to produce the enzyme cholinesrerase, a natural body chemical crucial for the transmission of nerve impulses. The poison acts to over- stimulate the body, which without this essential enzyme is incapable of controlling nerve impulses. The result is blurred vision, excessive sweating and salivation, stomach cramps and chest restrictions--and in extreme cases, death. (1980, p. 5)

Monoculture cropping patterns have led to much greater inputs of pesticides. A University of Georgia study on the environmental effects of these intensive cropping patterns warned that, "Pesticide usage is another input warranting special consideration because particular chemicals used in crop production can have adverse effects on stream water quality." (Clifton, et al., 1982, p. 6)

Pesticides are inadvertently destroying a wide range of beneficial soil organisms and their complex ecological habitats. According to Wolf, organic soil has about 11 tons of biological life per acre whereas the chemically-treated soil of industrial agriculture has only about 2 tons of biological life per acre. (1977, p. 8) This loss of organic materials contributes to soil depletion and erosion. (Rifkin and Howard, 1982, p. 3)

(2) Herbicide Pollution

Herbicides such as Agent Orange and 2,4,5-T have long been considered serious health hazards, but in general, herbicides have been considered less dangerous than insecticides since their detrimental health effects have been less well known. A recent study in Kansas, however, has linked the herbicide 2,4-D, the "backbone of all weed-control programs," to lymphatic cancer in farmers. (Cooper, 1986) Another study in Iowa found that people living in counties with high

herbicide use were 60% more likely to die of leukemia. ("Cancer and Farming", 1984, p. 4)

Growing concern over the environmental effects of herbicides has been expressed by groups such as the Edmonton-based "Toxic Watch Project." A recent report by the Environment Council of Alberta warned of a "major problem with widespread use of herbicides" such as Dicamba, 2,4-D, and MCPA, which must all be applied as sprays. These chemicals affect all broad-leafed plants and problems arise when the sprays are carried by the wind "to adjacent fields or residential areas where more sensitive, desirable plants are growing." (Sanderson, 1981, p. 22)

Herbicides which must be worked into the soil are also considered a pollution threat, especially to the water supply and to desirable plant life. When herbicides such as Avadex or Treflan are plowed into the soil, the soil is left in an erodible condition, easily removed by water or wind. As these herbicides persist in the soil for about 12 months, they can cause problems wherever they are washed or blown. Considering how serious erosion has been in Alberta in recent years, Alberta Agriculture is now encouraging farmers to reduce their use of such fall-applied herbicides. (Sanderson, 1981, p. 12)

(3) Nitrate Pollution

Industrial agriculture practices also tend to pose increased problems of water pollution by nitrates. Nitrogen is an essential ingredient to a healthy agricultural system, but in the excessive concentrations it tends to be found in industrial agriculture, it causes serious environmental problems. Nitrates are soluble and when they enter water bodies in large concentrations, they overstimulate aquatic plant growth. When the aquatic plants die, excessive

decomposition leads to reduced oxygen levels in the water. The water becomes unsuitable for wildlife habitation and recreation. (Sanderson, 1981, p. 18) The increasing centralization of livestock operations and the heavy use of highly-soluble synthetic nitrogen fertilizers are two features of modern industrial agriculture which contribute to this problem.

(a) Livestock concentration--In industrialized agriculture, farm animals are increasingly crowded onto centralized feedlots and other confinement facilities. This centralization of livestock creates a two-fold ecological problem. First, it makes the task of returning nutrients to the soil a more difficult problem than when they were returned "automatically" by the decentralized grazing of animals. Secondly, the accumulation of animal wastes is also a potentially serious nitrate pollution problem. A USDA report on the structure of U.S. agriculture explained that, "The concentrated production of livestock has made the disposal of the animal wastes a concern." (1979, p. 7)

(b) Synthetic nitrogen fertilizer pollution--A common argument in agriculture today is whether synthetic nitrogen fertilizer is the same as organically-derived nitrogen fertilizer. Defenders of synthetic nitrogen fertilizers argue that "nitrogen is nitrogen" and in many ways this is true. All atoms of nitrogen may well be exactly the same. Organic fertilizers are broken down into identical compounds as their synthetic counterparts.

But in a deeper, contextual sense, synthetic and organic nitrogen fertilizers are quite different. Synthetic nitrogen fertilizers are produced in concentrations and in soluble forms that have different

effects on the soil environment than the nitrogen derived from decaying plant matters and manures. A researcher at Esso Chemicals recently admitted that his company is trying to develop fertilizers that "won't leak into ground water from the soil."(Small,1987,p.8) In a balanced, healthy organic soil, fertilizer leakage is not as problematical.

Synthetic nitrogen fertilizers are major sources of agricultural pollution. One researcher noted that, "Nitrate pollution from fertilizer runoff accounts for over half of our water pollution and two-thirds of our solid waste pollution."(Rifkin,1981,p.140)

Not only is there the problem of water atrophication already described, there is the problem of soil pollution. A 1985 report of the Canadian Environmental Advisory Council explained the connection between synthetic nitrogen fertilizers and the acidity problem in Canadian soils:

> Unfortunately, 'acid rain' and use of nitrogen fertilizers magnify the acidity problems of some soils. In Eastern Canada measurable decreases in soil pHs have occurred and it has been estimated (Coote et al.,1980) that perhaps 40 percent is attributable to the acid rain phenomena and 60 percent to the use of nitrogenous fertilizers...[It] was estimated in 1981 (ASSWS) that by 1985 nitrogen fertilizer-induced acidity may require use of over 250,000 tonnes of lime per year in order to offset the yield-depressing effects of acidity in Alberta and northeastern British Columbia. (Bentley and Leskiw,1985,pp.8-9)

Similarly, a 1982 report from the University of Georgia recognized the hazardous impact of higher nitrate usage throughout the U.S., especially when applied in conjunction with high rates of irrigation.(Clifton,et al.,1982, pp.6,11) The report pointed to evidence that pressures for increased agricultural production in the short-term were leading to serious long-term ecological problems.

C. Social System Degradation

The social impacts of industrialized agriculture are more difficult to document. North American society has obviously reaped many short-term material benefits from a fossil-fuel-based food system. Social problems potentially linked to technological displacement are often of a qualitative nature, such as long-term social and environmental relationships, and cannot be easily quantified or fit into mathematical models. Jacoby has argued that our inability to measure these long-term social costs has contributed to a "relentless disregard of the human factor in agriculture" which he called "a significant feature of underdevelopment which leads to painful distortions of human relationships and use of land." (Jacoby, 1971, p. 83)

Among the quantifiable social problems are technological displacement, the decline of rural communities, the overcrowding of sprawling cities, the adoption of high-consumption and polluting urban lifestyles, and the disruption of global agricultural systems.

(1) Technological Displacement

Between 1940 and 1980, the U.S. farm population dropped by more than 22 million people, from over 30 million to under 7.5 million. (USDA, Agricultural Statistics, various years) The three main reasons behind this exodus from agriculture were: (1) mechanization; (2) reduction in the profit margin; and (3) job opportunities and comforts available in cities were not always available in rural areas. (USDA Economic Research Service, 1987)

Though this structural transformation of agriculture has generally been perceived as an inevitable, and even desirable, outcome of industrialization, a growing number of social costs are being

identified. In The Consequences and Challenges of New Agricultural Technologies(1984), Schmitz and Seckler argued that, "Technological displacement...remains the source of some of our greatest social problems."(1984,p.103) In the case of displaced farm families, the process of industrialization has involved growing farm debt, unemployment, the loss of land, and an increasing concentration of power and wealth.

a. Growing farm debt--As a by-product of higher production costs and overproduction, North American farmers have been caught in a cost-price squeeze. Between 1910 and 1980, net farm income rose by a factor of just over three, from $3.5 billion to $11.5 billion, but farm expense rose by a factor of nearly forty, from $3.5 billion to $128 billion.(USDA,Agricultural Statistics,various years) From 1972 to 1984, the rising cost of industrial inputs, coupled with high interest rates, pushed U.S. farm debt up by almost 700 percent to nearly $200 billion.(Borrelli,1984,p.22)

The threat of further agricultural displacement due to financial problems is immediate and pressing in the United States. A 1985 federal survey indicated that more than one-third of the nation's family farms would have failed within six months if a huge subsidy program for U.S. commodities had not been instituted.(Klose,1985,p.3A) But such subsidy programs are only short-term measures for a situation which may require a major restructuring of the agricultural system.

The systemic nature of the problem is reflected in the type of farmers that have been going broke in recent years. Earlier in the exodus out of agriculture, farmers tended to leave because they were too small, too old, or unable to produce "efficiently" according to

industrial standards. The reasons for farm bankruptcies have changed. A recent USDA report explained:

> Today, by contrast, farmers quitting for financial reasons tend to operate larger production-efficient farms. Many of them were considered progressive leaders in the farm community during the 1970's. They appear to be primarily young (under 40) and from the middle and upper middle segments of commercial agriculture. (USDA, ERS, 1987, p. 11)

b. Unemployment--As early as 1904, Quantance recognized the harmful effects of job-eliminating agricultural technologies and argued that, "The introduction of a harvesting machine throws cradlers and binders out of employment just as certainly as the introduction of water drives air out of a jug."(In Berardi and Geisler, 1984, p. 25)

Labor-eliminating agricultural technologies made more sense on the American frontier when tillable land was abundant and labor was scarce. But with today's dangerous dependence on fossil fuels in agriculture and high unemployment, it makes less sense to adopt technologies which take away jobs and consume larger quantities of non-renewable resources. Wagstaff pointed out that, "the decline in employment in one industry is a contribution, not to efficiency of resource use, but to unemployment."(Tracy, p. 315)

Shown below in **Table 1** is the decline of farming as a source of employment in the U.S. from 1940 to 1980. Of the total U.S. population, the percentage of farmers has been cut to less than two percent. A 1986 report of the U.S. Office of Technological Assessment (OTA) warned that another million farms in the U.S. are going to leave the land by the year 2000 unless something dramatically different is done to alter the current approach to agricultural development.

Table I.

The Decline of Farming as a Source of Employment

In the U.S. From 1940 to 1980

Year	# of Farms (thousands)	Total Labor Force	# of Workers on Farms	% of Workers on Farms
1940	6,096,799	55,640,000	11,671,000	20.98%
1950	5,382,162	63,099,000	10,531,000	16.69%
1960	3,962,520	70,612,000	7,057,000	9.99%
1970	2,954,200	85,959,000	4,522,600	5.26%
1980	2,432,510	109,042,000	3,705,300	3.40%

(Source: USDA, Agricultural Statictics, various years)

Many farmers have farmed all their lives and are not trained or experienced to pursue many of the typical urban occupations. Not only are these displaced farmers being denied their chosen occupation, many are being denied any kind of meaningful engagement.

Depicted in Table II below is the growing structural unemployment in Canada over the last three decades. A declining manufacturing sector is responsible for part of this structural unemployment. The fact remains, however, that a growing segment of the work force is unable to find work and agriculture continues to decline as a source of employment due to industrial technologies.

Unemployment has been linked to a series of escalating social pathologies in urban industrial society. Statistics on social problems arising from unemployment were presented recently by U.S. Representative James Weaver (D.-Ore.) in testimony before the House subcommittee on the effects of unemployment. For every 1% rise in unemployment, he said, "we can statistically expect" a 4.1% rise in

suicides; a 5.7% rise in homicides; a 3.4% rise in mental hospital admissions; a 4% rise in the number of prison inmates; and an increase in child abuse from 16% to 69% in counties of high joblessness. (*The Washington Spectator*, 1982)

Table II.

Noncyclical and "Hidden" Unemployment, Canada, 1961-79

Year	A. Noncyclical Unemployment Rate		B. Percent of Unemployment Noncyclical		C. Hidden Unemployment Rate	D. Chronic Unemployment Rate (A + C)	
1961	2.8		38.9		...	2.8	
1962	2.2		37.3		...	2.2	
1963	2.1		38.2		...	2.1	
1964	2.4		51.1		...	2.4	
1965	2.6	2.47	66.7	52.2	...	2.6	2.47
1966	3.6	Annual	100.0	Annual	...	3.6	Annual
1967	2.0	Average	48.8	Average	...	2.0	Ave.
1968	2.5		52.1		...	2.5	
1969	3.0		63.8		...	3.0	
1970	1.5		25.4		...	1.5	
1971	2.9		45.3		0.8	3.7	
1972	3.7		58.7		1.5	5.2	
1973	5.5		98.2		1.3	6.8	
1974	5.2		96.3		0.4	5.6	
1975	3.8	4.66	54.3	68.6	0.1	3.9	6.01
1976	5.1	Annual	70.8	Annual	1.8	6.9	Annual
1977	5.4	Average	65.9	Average	2.0	7.4	Ave.
1978	5.5		64.7		2.2	7.7	
1979	4.8		63.2		2.1	6.9	

(Source: Economic Council of Canada, 1982)

When unemployment is added to the mental health pressures of increasing farm debts, farm foreclosures, bank closings, and health problems resulting from ongoing contact with toxic chemicals, it is no wonder that the recent farm crisis has led to a higher rate of rural suicides. In Alberta, a recent study indicated that the suicide rate among farmers is well over twice that of the rest of the population.

It is ironic, too, that when displaced farm families cannot find work and are forced into unemployment, they often become dependent upon food stamp assistance from the U.S. Department of Agriculture. In

1975, for example, two-thirds of the USDA's budget was allocated for food programs to support the urban poor, "many of whom have been driven off the land by the Department's own pro-agribusiness policies." (Stavrianos, 1976, pp. 36-37)

For those who consider being engaged in meaningful work a basic desire of human life, the current pattern of technological displacement in agriculture is undesirable. Rodale has argued, "We need technological advance, yet we don't need new technology that is blind to the central fact that people need jobs." (1983, p. 33) Reviewing social conditions in the U.S., another agricultural analyst argued:

> In a nation where millions remain unemployed and trapped in decaying urban ghettos, it is ironic to hear agricultural officials bragging about how few workers are employed on the farms. The nation might promote a labor-absorbing system of agriculture--and provide generous incentives to attract urban emigrants back to the farms, as well as to keep rural citizens from leaving in the first place. (Zwerdling, 1978)

c. Growing concentration of land ownership--Describing the loss of land by millions of farm families, Gardner said, "For the families whose lives have been torn at the root, it has been nothing short of a mass expropriation by slow and steady increments." (1982, pp. 20-23) If current trends continue, future generations will increasingly be shut out of farming and will continue to lose contact with the land and a first-hand awareness of the workings of nature. In moving from the land, "we deprive ourselves of what is an elemental need of mankind: the inner discipline which comes from communion with the land." (Borsodi, 1929, p. 310) Similarly, Freudenberger warned that:

> New generations of citizens are now being denied a most basic human right. Our nation today must take a hard look at the consequences of this relatively new situation in American agriculture...to be denied the opportunity to participate in the ongoing process of creation is the deepest level of injustice. (Freudenberger, 1984, p. 101)

Table III is illustrative of the potential for higher farmer-to-land ratios in North America. Statistics from the Organization for Economic Cooperation and Development show that the United States and Canada have very low ratios compared to other developed countries. Only Australia, with its barren, dry outback, is even close to the U.S. and Canada in terms of the scarcity of people employed in agriculture on a per-acre basis.

Table III.

Agricultural Employment Statistics

for OEDC Countries, 1987

COUNTRY	% OF CIVILIAN EMPLOYMENT IN AGRICULTURE	PEOPLE EMPLOYED IN AGRICULTURE PER TILLABLE AREA (per 100 sq.km.)	PEOPLE EMPLOYED IN AGRICULTURE PER AREA TILLED (per 100 sq.km.)
Australia	6.2	9	86
Austria	9.0	832	1,915
Belgium	2.9	747	1,376
Canada	**5.2**	**83**	**126**
Denmark	6.7	583	643
Finland	11.5	1,116	1,198
France	7.6	510	845
Germany	5.5	1,146	1,849
Greece	28.9	1,127	2,612
Iceland	10.6	53	12,100
Ireland	16.0	291	1,742
Italy	11.2	1,335	1,878
Japan	8.8	9,460	10,690
Luxembourg	4.2	670	1,117
Netherlands	4.9	1,245	2,863
New Zealand	11.1	102	3,138
Norway	7.2	1,610	1,705
Portugal	23.2	2,280	2,640
Spain	17.6	599	910
Sweden	4.8	573	690
Switzerland	6.6	1,046	5,105
Turkey	57.3	2,390	3,180
United Kingdom	2.6	337	896
United States	**3.1**	**77**	**175**

(From: The Organization for Economic Cooperation and Development Agricultural Employment -- Agriculture, Forestry, and Fishing Statistics in The OEDC Observer, April/May 1987, pp. 18-19)

The poor and minorities are increasingly being denied access to land. Hispanics, for instance, perform much of the farm labor in America, yet own little land. Native Americans have traditionally had a reverence for the land and the life on it, but as Perry Wounded Shield explained in *The Nebraska Territory Indian News*, Native Americans, "were promised to be made into farmers and ranchers, so we laid down our way of life and ended up being beggars."

Among black Americans, the problem of displacement from farms is even greater. From a population of 600,000 black owner-operated farms on 46 million acres in 1940, it dropped to 50,000 black farm operators on 13.3 million acres by 1975. Black-owned land in the rural South has declined from 15 to 6 million acres since 1910. According to the publication *ruralamerica*, "Experts estimate that one million black-owned acres were lost between 1969 and 1974. At the present rate of attrition, by 1990, the black farmer will be as extinct as a buffalo."

Walls' book, The Chickenbone Special, described the migration of the black farm population from the rural South to the urban North for factory jobs. He explained that, "The important thing about this migration, I determined, was that it was an unwilling migration. Human beings were moving not because they chose but because they had to move." This forced migration to the city continues today. Blacks continue to be forced into the hopeless and debilitating environments of urban ghettos.

d. Growing concentration of wealth and power--All too often, it is the weakest segments of society which lose their livelihoods with the introduction of industrial technologies in agriculture. In a study of the social impact of the mechanical tomato harvester, Schmitz and

Seckler drew attention to the process by which science and industry create energy- and capital-intensive innovations at the expense of those farmers and farmworkers least to able adapt to the situation. They explained that the short-term successes of the industrializing sectors of society "creates consequences which bear unfavorably ... on less organized and therefore more vulnerable sectors."(Schmitz and Seckler, 1984, p. 115)

Rodale complained that people have long been told, "Get big or get out" by the "architects of modern farm technology."(1983, p. 32) The recent decline in the number of family farms has been even more rapid than analysts thought possible. In 1977, Berry noted that the *Progressive Farmer* predicted the disappearance of 200,000 to 400,000 farms in 20 years. (1977, p. 11) But a July 1986 editorial in the *Lincoln Journal* asserted that, "In just the last three years, more than 300,000 commercial farmers have gone out of business."("Decimation", 1986, p. 4)

Raup, a professor of Agricultural Economics at the University of Minnesota, spoke before the Subcommittee on Monopoly of the U.S. Senate Small Business Committee in 1972 on the changing role of the individual in the labor market with the the type of structural changes taking place in U.S. agriculture:

> One of the most pervasive consequences is that the occupational composition of the population changes. Instead of a large number of small entrepreneurs, combining the functions of manager and laborer, the occupational structure includes a small number of managers and a large number of workers. (Berry, 1977, pp. 171-172)

While this process of converting independent farmers into wage laborers in an industrial system is defended on the grounds of a reduction of labor needed for agricultural production, some scientists question whether, overall, the society is really benefiting. In a

Science article, Steinhart and Steinhart suggested that, "Yesterday's farmer is today's canner, tractor mechanic, and fast food carhop...One must ask if the change was worthwhile.'"(1974,p.310) Even if jobs are found by displaced farmers and income levels are stabilized, there is usually a decline in individual capacity for decision-making, risk-taking, and investment of family labor in farms and local businesses.

A recent editorial in *The Nation* compared the "forced corporatization" in U.S. agriculture from World War II to the present with the forced collectivization of post-revolutionary Russia. Of President Reagan's "free market" economy, which has sped up the process of "forced corporatization," it was argued that:

> Reagan's vision of agricultural paradise, like the Russian fellow's, is grounded in ideology. In this case it is the cure-all dogma of the free market. Let prices drop, production lag, unemployment soar, banks fail, towns die, dust blow. In time, the market will make it right. ("Clearing the Land",1985,pp.259-260)

If research continues to be guided by traditional standards of productivity and efficiency, emerging technologies will continue to be adopted by the wealthiest farmers to the disadvantage of smaller growers who cannot afford to change their ways. As a result, the number of U.S. farms, the U.S. Congressional OTA has predicted, are likely to be cut in half, to roughly one million, by the turn of the century and 50,000 huge farms will produce 75 percent of the nation's food. (Schneider,1986)

Unless there are fundamental changes in the values of many sectors of industrial society, new challenges to the living systems of agriculture will continue to arise and grind away at the ecological and social systems that make up agriculture. Douglass described the

concern of some agricultural analysts:

> ...[In] the spread of modern scientific agriculture they see also a form of disenfranchisement which is not only redistributing unjustly the power to make decisions in rural areas all over the world, but also one which is weakening the social and cultural institutions on which sustainable agriculture must depend. (1984, p. 19)

(2) Decline of Rural Communities

With the demise of the family farm, many rural communities and counties have been faced with a long and depressing process of decline. On the average, for every six farmers that leave, one small business goes broke. This leads to the gradual abandonment of small towns and the wasted capacity of community infrastructures like streets, sewers, water systems, schools and churches. Large corporate farms may continue to profit, but many small towns gradually and painfully become ghost towns. As Ruttan has observed, "A prosperous agriculture no longer implies a prosperous rural community."(Ruttan, 1966).

Raup described the process by which large corporate farms are able to "practice selective internalization of benefits and externalization of costs" at the expense of the community. (Berry, 1977, pp. 171-172) The trailer house has become the symbol of the large corporate farm, reflecting the transient nature of the increasingly dependent labor force. Rural communities receive the immediate impact of this process in terms of settlement and lifestyle patterns. Raup explained the effect of being dominated by large industrial agribusinesses, arguing that:

> Community institutions suffer from lack of leadership, and from the lack of a sense of commitment on the part of the labor force to long-run community welfare. Those institutions that survive take on a dependent character, reflecting the paternalistic role of the dominant firms. (Berry, 1977, p. 171)

In assessing the effects of industrial agriculture on people and

communities, the work of Goldschmidt is often cited. He studied rural communities in California in the late 1940s and came up with what has become known as the **Goldschmidt Hypothesis**. He argued that the decline of family farms contributes to the decline of rural communities. As farms increase in size, decline in number, are increasingly mechanized, and increasingly corporate owned and operated, a process takes place that "tends to lead to the socioeconomic decline of rural communities and regions."(Buttel,1983,p.107) As Douglass explained:

> ...family-type farming communities seem to support more people at a measurably higher level of living and with less large income disparities than communities dominated by larger operations; they apparently provide better community facilities and services, moreover, such as schools, parks, paved streets, sewage disposal, newspapers, civic organizations, and other public services; and they appear to encourage more institutions for democratic decision-making involving all the citizens, than their non-family related counterparts.(1984,p.19)

Goldschmidt's hypothesis has been tested and confirmed in different places since his pioneer work. Swanson, of the Center for Great Plains Studies, recently studied the demographics of 27 rural counties in Nebraska from the end of World War II through 1984 and reached a similar conclusion. As farmers leave the land, the economic and social base of rural communities decline. Small businesses, schools, churches, and other community institutions suffer and are gradually abandoned.

Swanson warned that continued trends toward fewer and larger farms would mean the eventual extinction of many towns in Nebraska with fewer than 900 inhabitants. He projected that by 1990, those towns will be struggling to survive because they are too small to attract industry and there won't be enough farms to support their businesses, schools and other important institutions.(Looker,1986,p.3c) Many small, once

thriving, communities are destined for extinction by the turn of the century. These communities, along with their housing, roads, water lines, sewers, and schools are becoming ghost towns, in large part, because of the direction which agricultural technology is moving in Nebraska and throughout North America.

In many rural areas, there is steady drive toward bigger machines in fewer metal sheds, fewer farmworkers in fewer farm houses, and an atmosphere of old age, loneliness, poverty, and hopelessness. Johnson argued that:

> [Rural areas] have been transformed into efficient but dehumanized agricultural landscapes. The young people have been able to leave without much difficulty, but older people have had to face the decision of accepting poverty rather than uprooting themselves from the places they feel accustomed to. (Johnson, 1978, p. 66)

.....Industrial agriculture tends to subvert the human need for domestic permanence and community. In many cases, it has also replaced a neighborliness for a predatory attitude in which farmers become convinced that it is better to have a neighbor's farm than to have a neighbor. In what Cochrane (1980) called agricultural "cannibalism," larger, more aggressive farmers have out-competed and bought the lands of their less successful neighbors. (Buttel, 1983, p. 112)

In agricultural regions of North America, the future of rural communities will largely be determined by the direction of agriculture. If farm numbers and the farm population continue to decline, so shall many rural communities. (Swanson, 1984, pp. i-ii) In the process, new urban problems of unemployment and anomie are likely to continue rising.

(3) Overcrowding of Sprawling Cities

As rural residents are forced into cities by the increasing

industrialization of agriculture, cities become overcrowded. This puts pressures on housing, on job markets, and on farmland on the suburban fringes of cities. The cities sprawl outward, often consuming prime agricultural lands. This is a problem in the U.S., where nearly a million acres of prime cropland per year were converted to nonfarm uses from 1967 to 1977. (USDA, 1980) It is an even bigger problem in Canada, where there is less prime agricultural land to begin with. A recent study of changing land-use patterns in Canada indicated that half of the farmland lost to urban expansion is coming from the best one-twentieth of the farmland. (SCC, 1976)

Displacement of the farm population in the U.S. has led to a situation in which less than 5 percent of the population produces all the food and 80 percent of the people are crowded onto about 1 percent of the land. (Gardner, 1982, p. 28) As Schumacher observed, most of the population in the U.S. is polarized into three immense megalopitan areas with "the rest of the country being left practically empty; deserted provincial towns, and the land cultivated with vast tractors, combine harvesters, and immense amounts of chemicals." (Schumacher, 1973, p. 64)

A USDA study documents the fact that there may be a substantial portion of the population in the U.S. that is unhappy being crowded into cities. **Table IV** below identifies the current residence and the residential preference in the United States. The study suggests there may be 12% of the U.S. population, or about 30 million people, living in cities or suburbs which would prefer to live in smaller towns or rural areas if opportunities were made available.

Table IV

Residential Preference in the United States, 1978

	ACTUAL RESIDENCE	PREFERRED RESIDENCE
LARGE CITIES AND SUBURBS	31%	19%
MEDIUM-SIZED CITIES AND SUBURBS	48%	55%
SMALL CITIES AND NEARBY LOCATIONS	16%	20%
RURAL VILLAGES AND COUNTRY	5%	6%

(Source: USDA Economic Development Division, Rural Development Perspectives, November, 1978.)

(4) Adoption of High-Consumption Urban Lifestyles

High-consumption lifestyles adopted by an urban industrial society contributes to pollution and has a negative impact on agriculture's ecological sustainability. Air pollution is just one group of "pollutants which do damage to renewable agricultural resources." (Douglass, 1984, pp. 12-13) By burning massive quantities of fossil fuels such as coal and oil, an estimated 150 million metric tons of sulfur and nitrogen oxides are released into the atmosphere each year in the U.S. alone. (Freudenberger, 1984, p. 49) Not only do these noxious gases become chemical rains which poison the water and land, but they also create a smog that disrupts the penetration of light from the sun. The Swedish Academy estimated that an increase of 1% in the emission rate of nitrous oxide causes a 0.2% decrease in stratospheric ozone. (Freudenberger, 1984, pp. 20-21)

Ironically, the production process for chemical fertilizers releases high levels of noxious gases. Freudenberger reported that a phosphate fertilizer plant in Florida releases fluoride and sulfur oxides at rates sufficient to have blighted numerous citrus orchards

and in highly industrialized New Jersey, pollution injury to vegetation has been observed in every county, and damage has been reported to at least 36 commercial crops. (1984, p. 50) He also warned that, "The heavy use of inorganic fertilizers and their impact upon the ozone sheild must be considered when we ask about food for tomorrow." (Freudenberger, 1984, pp. 20-21)

Despite the high consumption of energy in industrial agriculture production, only about 20 percent of the energy used in the food system goes toward the actual growing of food. The remaining 80 percent is consumed by processing, packaging, distribution, and preparation of food products for distant urban markets. (Rifkin, 1980, p. 134) This high energy cost from the field to the consumer is also a product of the industrial mode of production. Since industrial agriculture has forced most of the farm population off the land and into cities, food must be shipped long distances and packaged for commercial markets, rather than consumed on location by an indigenous population.

There is so much fossil fuel energy consumed in the industrial agriculture process, several analysts have argued that the food we eat is, in effect, "grown from oil rather than soil." (Rifkin and Howard, 1982, p. 3) Green argued, "We cannot go on eating oil for very much longer." (1978, p. xiii) If we are to continue to extract and consume increasing amounts of fossil fuels to produce food, Johnson argued, "the likelihood of the rapid decline of energy available later would be dramatically increased." (1978, p. 175) So rapid is the depletion of fossil fuels through the current industrial agriculture practices in North America, that the Pimentels have presented evidence indicating:

> If every nation followed the American practice in food production, processing, and distribution, all known gas and

> oil reserves would be used up in about 11 years. In other words, all presently available gas and oil would have to be used strictly for agricultural production, food processing, and distribution purposes to feed the world's present population of more than four billion people. (1979, p. 137)

The growing energy-intensity of agriculture, traditionally an energy-producing system, has ominous implications for the global future. Boyden noted that, "On the global level, the amount of energy flowing through human society is doubling about twice as fast as is the population." (Boyden, 1979, p. 14) To continue producing food for a growing global population at a increasing energy deficit "is less a sign of nature's renewable bounty and our knowledge and more a sign of her forgiveness and our discount of the future." (Jackson, 1984, p. 165)

(5) Disruption of Global Agricultural Systems

Not only is the rural vitality of North America in jeapordy but, due to the interconnected nature of the international market system, virtually the entire global agricultural system is affected by agricultural industrialization. De Janvry explained:

> ...the subjugation of all levels of agricultural activity to the discipline of markets, the integration of farming all over the world into the agribusiness chain, and the heightened internationalization of agricultural markets -- seems destined to weaken still further the small independent farmers of the United States and the developing world, and to skew the distribution of benefits towards the larger, wealthier, agribusiness-linked competitors. (de Janvry, 1982, p. 26).

A number of development analysts have described how small farmers around the world are being linked into dependency relationships by world market situations that are outside their control. (Ashby, 1985, p. 379) In some developing areas of the world where industrial technologies are replacing long-standing agricultural systems, ancient cultures are being destroyed, whole societies are being uprooted and forced to relocate and some areas are facing "the final destruction of

paleolithic and neolithic life as the last vestages of pre-agricultural technology are literally plowed under by the agricultural-industrial frontier."(Day,1982,p.261) Speculating on the eventual outcome of such a trend, Henderson charged that:

> In systemic terms, this type of world-trade 'game' reaches some hypothetical global equilibrium when the winners have disordered every local social system and despoiled every local ecosystem; that is, when the economic behavioral sink has become global.(1981,p.193)

Meadows, one of the co-authors of the first Club of Rome report, suggested that, "There may be no more important social problem in this century than the increasing imbalance between human population and the resource base that sustains it."(Freudenberger,1984,p.13) Evidence presented in this chapter has suggested that industrialized agricultural systems have the potential for exacerbating the imbalance between humanity and the natural resource base by contributing to resource depletion, agricultural pollution, and social degradation.

CHAPTER V

VALUES OBSTRUCTING AGRICULTURAL SUSTAINABILITY

Many have challenged the sustainability of the basic beliefs and values on which industrial society operates. Milbrath explained that these beliefs and values make up the **dominant social paradigm**, or **DSP**, which reflects how a wide spectrum of social groups believe the world works physically, economically, socially and politically. He argued that:

> The DSP that undergirds modern industrial market society worked reasonably well when the world was less crowded and humans were less destructive of their ecosystem. Now we are swiftly destroying the carrying capacity of our ecosystem leading many people to conclude that modern society with its aggressive competitive value structure is not sustainable. (Milbrath, 1984, pp. 2-3)

An attempt is made in this chapter to identify and examine three basic value assumptions of industrial society which seem to obstruct the long-term ecological and social sustainability of agriculture. These basic value orientations include: (1) The Industrial/Mechanistic Value; (2) The Short-Term Private Interest Value; and (3) The Metropollyanna Value: The Urban Bias.

These value orientations are inferred from the actions taken by leading sectors within the industrial paradigm, including the agricultural sciences, orthodox economics, governmental entities, and corporate interests. As Enk and Hornick point out, "...values, attitudes, and beliefs are not directly accessible to observation, but they can be inferred from a person's statements, behavior, and decisions." (1983, p. 59)

A. The Industrial/Mechanistic Value

This is the notion that we can dominate nature by applying mechanistic industrial technologies rather than developing more

sophisticated, holistic technologies which cooperate with nature. It is a faith rooted in the Industrial Revolution when the conditions of seemingly limitless natural resources and a smaller population led to a faith in large-scale industrial production.

Industrial research and practices tend to reduce agriculture to simple, fragmented parts using production per man-hour or per acre as the primary criteria by which to judge the system. The approach of developing greater efficiency by reducing the production process to a series of sub-processes was developed by Taylor in the nineteenth century to increase industrial productivity in the U.S.

Though the reductionist techniques of Taylorism have helped to increase productivity in agriculture, they have also contributed to environmental degradation and to the dehumanization of production by neglecting to adequately consider the negative externalities to the system as a whole of each technological change. Hayden recognized these negative externalities and warned that:

> ...a much more intensive effort to assess the holistic consequences of agricultural technology needs to be undertaken in the future. We must remember that technological research is guided many times by criteria other than those that sustain and revitalize the socioeconomic community. (Hayden, 1984, p. 217)

The theoretical deficiency of the mechanical worldview can be demonstrated by comparing it with the ecological worldview. According to the mechanistic model, "what a thing is in itself is independent of its relations to other things." (Cobb, 1984, p. 211) This was theoretically plausible as long as there was reason to believe that the ultimate level of reality was really simply matter in motion. When scientists smashed the atom, however, they found that the basic elements of all matter are better viewed as "a field of energy no part of which can be abstracted from the rest without altering the character

of all."(Cobb,1984, p.211) The basic component parts of the atom, then, are better scientifically depicted by the ecological model.

According to the ecological model, what a thing is in itself is a function of its relation to other things. Nothing is completely self-contained. Cobb argued that this is true of the ultimate entities of which the universe is composed and it is especially true of living things. (1984,pp.211-212) This is not to say that the mechanistic aspects of things have no relevance. It is to say, however, that many applications of the mechanistic model to ecological systems in agriculture are theoretically incorrect and inappropriate.

The mechanical view of economics limits the degree to which the problems of agriculture can be seen in their interconnection. Lost is the relational wholeness and the greater ability to get at the root of related problems which can be achieved by an ecological perspective. Harris explained that:

> The problem isn't lack of awareness, rather ecological issues aren't seen in their interconnection. As a result there is little attempt made to look for the fundamental causes of the destruction of the ecosystem. No attempt is made to see the relation between ecological destruction and social and economic crises.(Harris,p.13)

By failing to recognize the interconnected complexity of ecological and social systems, we often tend to deal with complex problems with cosmetic and band-aid approaches. Many of the social problems of society result from a failure to place our actions within a contextual framework. Boyden explained that:

> There is good reason to suspect that the fact that so many problems of modern society, such as increasing violence and abuse of hard drugs, not only persist, but continue to worsen, is due to the ad hoc, piecemeal nature of our cultural adaptive response to them. (Boyden,1979,p.67)

Unwilling to admit to fundamental flaws in the values upon which the industrial/mechanistic approach to agriculture is built, North

Americans have tended to embrace industrial agriculture even more fervently. Mumford argued that many Americans "worship" their machines and that, "They have confused progress with mechanization."(Peter, 1977, p.406) Similarly, Fromm observed the growing infatuation of modern society with an industrial/mechanistic value orientation and argued that:

> Industrial society has contempt for nature--as well as for all things not machine-made and for all people who are not machine makers...People are attracted today to the mechanical, the powerful machine, the lifeless, and ever increasingly to destruction. (Fromm, 1976, p.8)

(1) The Agricultural Sciences

Much has been learned from the application of mechanistic values by the agricultural sciences. Many vital relationships which make up healthy and sustainable agricultural systems, however, have been neglected and distorted. The industrial notion that, "all relationships are mechanical [is] a view that grossly oversimplifies the complex forces at work on a farm."(Looker, 1986, p.5) The mechanistic approach often assumes that what does not fit into a particular simplified model can safely be ignored. (Fukuoka, 1978, p.xi) By reducing complex living systems to mechanical, industrial processes, however:

> ...we have constructed a deficient code for reading nature, leading to a deficiency in interacting with nature. The root cause lies in the very foundations of our scientific world view; and in the very perceptions which this world view engenders. (Skolimowski, 1981, p.vii)

Whereas the Greeks and other cultures have elevated all the world to one living system, the reductionist values of the mechanistic worldview are more concerned with splitting life down to its subparts and with classifying dead things. There is a tendency to focus more on individual cells than on a holistic view of the whole body. In much of agriscience, Fukuoka argued, "Modern research divides nature into tiny

pieces and conducts tests that conform neither with natural law nor with practical experiences."(1978,pp.74)

When the mechanistic worldview is inappropriately applied to living systems, life is often reduced to a dead, mechanical process. Skolimowski argued that this has contributed to a philosophical lack of social concern in the value structure of scientists and of society in general:

> Contemporary philosophy cannot help being spiritually dead, for its universe is dead: inanimate matter, physical facts, objective logical relationships. For this reason, having at its disposal the concepts that are specific to this dead universe, it cannot help being socially unconcerned, for social concern is not an objective category.(1981,p.50)

The reductionist bias inherent in the mechanistic worldview of many agriscientists is leading to increasing dependence on purely mathematical and statistical analysis. These models tend to have less and less connection to the cultural and ecological base of agriculture. The temptation is to assume that the information contained in mathematical and statistical models is adequate and that if some facts do not fit the model then the facts must be wrong. The models can then be adjusted to come up with the results which fit into the urban industrial paradigm. These models may or may not relate to the reality of agriculture as a multi-level living system.

(2) Orthodox Economics

The operant word used by many economists to frame their mechanistic worldview is "externalities." Economists tend to set up mechanical models and reduce all unwanted variables to the marginal status of "externalities." In this process, economists often neglect the predominantly ecological nature of relationships within living systems. In the process, many of the severe problems of agriculture

have been treated as mere "externalities" of "sound economic equations."

Through the "creative accounting" of large, powerful institutions in urban industrial society, ecological and social costs are externalized. In the artificial, mechanistic environment of money markets, governments and corporations can manipulate the money supply, the bank reserve system, and speculation in commodity "futures" through paper transactions. In the process, economists have helped to create the "elaborate pathways to self-delusion that characterize today's financial halls of mirrors." (Henderson, 1981, p. 41)

In the conservative atmosphere of North America in the 1980s, many university programs in agricultural economics are increasingly based on statistical and mathematical models. Many agricultural problems, however, do not lend themselves to quantitative measurements and cannot yet be expressed in these mathematical models.

If the long-term health of ecological and social systems is the real standard of worth, serious questions could be asked about the common economic notion that the worth of something is determined only by its monetary price. Within this monetary mind-set, "We are hypnotized to the fluctuating interest rates--ruled by economic policy rather than objective phenomena."(Henderson, 1981, p. 32) By focusing on pecuniary, monetary issues, it becomes easier for many economists to avoid more substantive issues like the environmental and social problems in agriculture. Schumacher complained of economics that:

> If it cannot get beyond its vast abstractions, the national income, the rate of growth, capital/output ratio, input-output analysis, labour mobility, capital accumulation; if it cannot get beyond all this and make contact with the human realities of poverty, frustration, alienation, despair, breakdown, crime, escapism, stress, congestion, ugliness, and spiritual death, then let us scrap economics and start fresh. Are there not indeed enough 'signs of

the times' to indicate that a new start is needed?(1973, p. 70)

Cost-benefit analysis tends to be a mechanistic process in which economists use the dollar values of various factors in order to make decisions. U.S. Congressman G. Brown explained that in debates over the rationality of present agricultural resource use patterns, the cost-benefit analysis of economists has been inadequate in dealing with many problems. All too often, short-term market prices are put on irreplaceable agricultural resources. For example, when the National Agricultural Land Survey (NALS) presented evidence of high levels of soil degradation in the U.S., the typical reaction was to a call for studies of erosion- productivity relationships. G. Brown warned of the dangers of such an approach to agricultural problems:

> ...many analysts and leaders in positions of authority are steadfastly determined to find a mathematical formula that will allow us to walk ever closer to the edge of resource exhaustion. (G. Brown, 1984, p. 148)

The law of entropy could be used by economists to help define the long-term cost of current nonrenewable energy depletion, but Rifkin noted that, "The economic profession has still not understood that the entropy law is the basic physical coordinate of scarcity."(1980, p. 131) In reality, industrial activities are human interventions into ecological cycles which take low entropy inputs and convert them into temporary utilities before discarding them back in the form of high entropy wastes.

From the perspective of the law of entropy, excessive consumption rates of energy resources are seen as threats to future generations. In the accounting system of orthodox economic theory, however, the consumption of energy resources is generally perceived as a boost to the gross national product and is a sign of a healthy economy. (McRobie, 1976, p. 114) In fact:

> When we glorify high energy production, then, what we are really promoting is an ever greater consumption of the finite resources of the planet. Seen in this way, the gross national product is more accurately the gross national cost, since every time resources are consumed they become unavailable for future use. (Rifkin, 1980, p. 136)

Economists have made the critical mistake of treating these nonrenewable resources as income rather than ecological capital in their models. As a result, "Agriculture has been operating as an increasingly energy- intensive system, and the over-exploitation of our income resources may well turn them into non-renewable resources." (McRobie, 1976, p. 114) Schumacher (1973) challenged urban industrial society's abuse of an even broader range of ecological capital, explaining that:

> To use the language of the economist, it lives on irreplaceable capital which it cheerfully treats as income. I specified three categories of such capital: fossil fuels, the tolerance margins of nature, and the human substance. (p. 19)

Berardi and Geisler have challenged the orthodox approach to "economic efficiency," seeing it as an ecological and social threat to the health of agricultural systems. They argued that:

> By its almost exclusive reliance on economic efficiency and conventional productivity criteria, current agricultural technology is biased against social equity for small farmers and rural communities. Simultaneously, the system masks growing threats to soil and water resources--which being central to community sustenance--are viewed here as social indicators. (1984, p. 213)

The important point to be made here is that the values which frame many mechanistic economic theories are such that not only are unhealthy agricultural development patterns condoned, but they are seen as signs of economic progress. Out of a concern for ecological health, Hicks argued that:

> Inherent in purely economic solutions of problems are greater and more rapid onslaught on the ecosphere, by the use of machines and chemicals, together with loss of human contact with the soil, and therefore loss of a conservation outlook. (Hicks, 1975, p. 51)

Since many economists inadequately recognize the connection between economics and soil erosion, a soil scientist has made the

connection between soil erosion and economics. McGill brought up the issue of the connection between soil degradation and economic problems in agriculture. He (1985) persuasively argued that soil degradation is already reducing the productivity of Canadian agriculture though the extent of the declining economic productivity of the land has been masked by increasing amounts of agrichemicals. He concluded that:

> ...land degradation is as much a part of the present economic malaise in agriculture as weather or prices. While the biophysical realities have been documented, the economic links are more nebulous. (McGill, 1985, pp. 183-184)

Inherent in much economic theory is the faith that "the magic of the marketplace" will guide society toward prosperity and stability. Orthodox economists argue that the "free market" will decide when the depletion of soil and fossil fuels is a serious problem. They say that resources will be conserved when they are depleted enough to make it profitable to conserve.

The absurdity of this argument is that when these resources actually become depleted, it will take millions of years of evolution to replace them. By the time they are depleted, it will already be too late for future generations. But as G. Brown complained, equity and ethics concerns are usually short-changed in the market economy:

> Unfortunately, neo-classical economics is essentially silent on fundamental questions of equity. Not only is it silent, but our predominant body of economic knowledge lacks the generic capability to consider ethical concerns. (G. Brown, 1984, p. 157)

(3) Governmental Entities

A short-term mechanistic worldview is often reflected in the simple and practical political notion that to be elected, you have to please the constituency with immediate results and benefits. When much of the society is working on a short-term, mechaninistic perspective, there is a natural tendency for politicians and government officials to

look for simple, short-term solutions rather than taking on long-term ecological perspectives.

Even when there is careful foresight put into governmental programs, the compromises required in the legislative process often result in a watering down of the original intent of these programs. The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), adopted in 1947 and rewritten in 1972, is an example of legislation which was intended to protect the environment and people, but was weakened by compromises in the legislative process. Wiles argued that FIFRA provides little protection for farm workers because it was "a political compromise forged under intense pressure from both the farm lobby and the chemical industry."(Wiles,1985,p.306)

Agencies like the EPA are required to use a cost-benefit analysis process which balances the protection of health against the cost to growers or anyone else "throughout the agricultural economy." The effect of this procedure is explained by Wiles in the case of chlorobenzilate, a pesticide:

> Scientists estimate that the chemical might induce as many as 1,400 cases of cancer per million workers, particularly among mixers, loaders and sprayers...For reproductive disorders, the number ranged between 371 and 1,884 per million...The EPA did not cancel the pesticide's registration, however. Arguing that other substances would cost citrus growers $57 million a year more, agency officials focused on ways of reducing the risk to 'acceptable' levels. (Wiles,1985,p.306)

Similarly, Feldman (1980) described how the EPA, created in 1970, has been compromised by amendments in 1976 and 1978. In these amendments, responsibility for enforcing the proper use of pesticides was turned over to the states. In addition, because of a major backlog of new pesticides waiting for approval, EPA has been allowed to "conditionally register" new pesticides before all the facts are in.

(Feldman, 1980, p. 6)

The value orientation of the Reagan administration has been to provide less funding and less regulatory power for agencies like the EPA. This has magnified the obstacles in the path toward the development of a more sustainable agriculture, as Clifton explained:

> As less national emphasis is directed toward regulatory policies aimed to improve environmental quality, new systems of agricultural production which minimize on-site damage must be explored and encouraged. (1982, p. 16)

(4) Corporate Interests

Industrial agriculture's reduction of living systems to the mechanical can be seen in the treatment of animals in "factory farms." The mechanistic approach to agriculture seems to accept the Descartian notion that only humans are able to feel pain and that chickens or hogs have no more realization of pain and suffering than an inanimate object such as a table. Lovelock expressed his skepticism about this approach toward animals:

> I have often wondered about the allegation that Descartes likened animals to machines because they had no souls whereas man with his immortal soul was sentient and capable of rational thought...Whether or not this was his belief, the dreadful notion was credible to many in his time and has had a long run since. It illustrates the extent isolated from the natural world. (1979, p. 135)

Corporate values are often expressed through corporate advertising. The radio, television, and printed media are flooded with promotions for the input and output industries of agribusiness. This steady barrage of advertising goes well beyond educating consumers about products. It helps shape the way people perceive the world. A farmer from Nebraska recently stated that, "People get brainwashed by expensive chemical ads, TV and radio reports, university professors, and extension agents." (Wolf, 1977, p. 72)

As early as the 1920s, Borsodi recognized the powerful role of

corporate advertising in the decline of small diversified farms and rural communities in North America. He said, "It is to be hoped that social historians will not underestimate the part which advertising has played in creating the folkways of the period through which mankind is at present passing."(1929,p.90) The media blitz by advertising has had a powerful influence on channelling agriculture in a particular industrial direction.

The values of chemical manufacturers have promoted a chemical, industrial approach to agriculture rather than a biological, ecological approach to agriculture. In The Corporate Alchemists: Profit Takers and Problem Makers in the Chemical Industry, Davis discussed the power of the chemical industry and the ecological threat it presents to the world. He argued that:

> The chemical industry is at least as powerful as the oil industry. Its products are everywhere; its hazards threaten the entire planet...Despite a rise in environmental concern and the enactment of much legislation, the author argues, no law to date has adequately dealt with the pressures the chemical companies still feel [for new products before everyone else]. (Davis, 1984)

The commercial agricultural sector is so vast and active that public researchers are unable to keep up with the array of agribusiness products that threaten ecological and social sustainability. U.S. Congressman G. Brown acknowledged the dangerous overload of new agricultural products. He explained that public institutions are unable to keep up with the testing necessary to adequately protect the environment and the public from hazardous new products, warning that:

> Concerns of resource degradation and misuse become submerged by the steady flow of new pesticides, available across rural America. Lacking the funds and scientific resources to track in a timely fashion the long-term effects of contemporary agricultural management practices, the ability of the government to prevent localized resource disasters will be severely curtailed. (G. Brown, 1984, p. 151)

B. The Short-Term Private Interest Value

The value system encouraging short-term private benefits at high long-term public cost is leading to an ecological and social trap. While having access to material things is essential for life, the problem is that urban industrial society is not able to recognize when enough is enough. Naegel has explained that:

> The average citizen is neither willing to give up certain acquired conveniences that have negative environmental impacts nor ready to sacrifice aspirations of increased material welfare. (Naegel, 1983, p. 12)

When patterns of excessive short-term consumption and pollution are challenged, a common defensive response is that, "We can't go back to the horse and buggy days or back to living in caves." There appears to be value-based unwillingness to recognize that, "Ways can be found to limit population, husband resources, protect the ecosystem and yet find richness and quality in living that is not dependent upon heavy consumption." (Milbrath, 1984, p. 6)

Many analysts have argued that it is the market system, with its inherent need to continuously expand in order to survive, that prevents society from reaching a steady-state equilibrium with the environment. North American society, they say, has tended to allow short-term private interests to dominate. Milbrath argued that, "Modern industrial societies that use the free market for making societal decisions have given greater emphasis to selfishness, competition, and maximization of material wealth." (1984, p. 2) Jackson added that:

> Until we begin to acknowledge that giving the green light to capitalism prevents us from really solving the problems, the environment will remain speechless, soil will erode, and farmers will remain broke, dispersed, and relatively quiet. (1986, p. 17)

While capitalism appears to be leading the way in self-interested development, socialist countries are also facing problems related to

increasing material consumption. The relative absence of material acquisitiveness in "primitive" tribal cultures, however, indicates that it may be less an inherent drive than a product of social circumstances. (Fromm, 1976, p. 7) In reality, it is utopian to believe that the human race can continue to consume increasing amounts of the earth's finite resources. Medawar asserted that:

> The goal of a happy, high-consumption world cannot be fulfilled even for the 3.5 billion people now alive, much less the 6 billion expected by the year 2000. At the American standard of living, the earth could support only 500 million. (Stavrianos, 1976, p. 138)

From the global ecological perspective, it is absurd for human beings to think they can pursue their own short-term good at the expense of the rest of the biosphere and its soil base. Such efforts are already damaging the environment and the human condition. (Cobb, 1984, pp. 215-216)

(1) The Agricultural Sciences

Agricultural research is often distorted by approaches dictated by short-term monetary profitability. Rural sociologists, for example, have tended to take "the safe and well-financed road," making sure that their studies fit into traditional approaches and fundable topic areas. In a 20 year survey of articles published by the Natural Resources Research Group of the Rural Sociological Society, it was found that the research priorities of federal agencies funding research have tended to dictate the type of problems approached and studied. (Burch and Wade, 1985, p. 92) In keeping with federal funding priorities, issues like wilderness carrying-capacity have been studied extensively while broader, more pressing issues such as soil erosion, agrichemical contamination and rural community decline have received less attention. (Burch and Wade, 1985)

Similarly, Friedland's 1984 study of agricultural researchers in

their university laboratories at Davis, California concluded that the primary, and often only, concern of researchers was with meeting the expectations of the funding source. When the funding source had interests contrary to those of long-term ecological and social survival, this could have presented a problem of conscience. Instead of social concern, however, Friedland observed what he called the **"Social Sleepwalker Syndrome"** which he suggested has been typical of researchers in the land grant college system. He explained that:

> ...few scientists with whom we met and worked placed their research in a larger social context. 'Social,' in other words, was limited to the organized constituencies and linkages which fed funds and research problems to the researchers. The larger social context...seemed lost on the researchers. With only very minor exceptions, they operated as if the social context with respect to the farm was neutral. (Friedland, 1984, p. 201)

Vogeler's analysis of agricultural researchers backs up Friedland's critique. He argued that agricultural researchers have shown little interest in the social consequences of large-scale farming even though numerous studies have shown smaller farms to be more productive. He complained that this leads to an agricultural system which reflects the values of powerful urban industrial interests rather than the values of an ecologically and socially healthy agriculture. He explained that:

> By researching aspects of productivity without regard to human consequences, these scholars reflect and perpetuate the ideological bias of agribusiness and the monopoly capital from which it springs. (Vogeler, 1981, p. 251)

Berry charged that many North American agricultural researchers have become "intellectual mercenaries," serving the interests of power and short-term private interests. He said the aims and disciplines of agriculture have been subverted by the ambitions of merchants, industrialists, bureaucrats, and academic careerists. (Berry, 1977, p. 33) He accused "upper crust" academicians of "agricultural vandalism" in

creating social and ecological costs for society. (Berry, 1977, pp. 167-9)

Similarly, Magidoff challenged agricultural scientists, saying:

> ...the scientific community in this country tends to concentrate its attention on the search for ways to enhance relatively short-term productivity and profitability of existing technological systems. Much less attention has been given to the identification of sustainable agroecosystems, and virtually no social scientific effort has gone into the development of sustainable rural communities. (Magidoff, 1986)

A social Darwinist orientation has tended to dominate the agricultural sciences. (Goldschmidt, 1978) It is an attitude that the soils, the farmers, and the communities which are dying ought to be dying. It is not uncommon for agricultural academics, protected by tenure, to argue for the displacement of one-third or more of the farmers in North America, calling them "bad managers," rather than questioning whether the overall system is poorly designed. (Berardi and Geisler, 1984, p. 19)

Even when academics recognize the growing ecological and social breakdowns taking place in North American agriculture, their internal, psychological defense systems often take over in defending the conventional, industrial approach to agriculture. Berry argued that a rigid industrial orthodoxy takes over to prevent more sustainable alternatives from being investigated:

> This obviously defines the necessary condition for a fierce and self-protective orthodoxy--a science-as- superstition, by which one clings to the assumption of the goodness of one kind of knowledge out of fear of knowledge of another kind. This fear makes the specialist scientist not merely willing to define a possibility, but desperate to define the only possibility. Only this desperation can explain the venomous contempt with which agricultural establishmentarians dismiss suggestions of other possibilities, old or new. These 'objective' scientists exhibit an intense craving to be right--a craving hardly diminished by the profitability of their faith. (1977, p. 173)

Agriscientists seeking alternatives to conventional agriculture often face serious obstacles, such as those described by Professor Haynes of Michigan State University, a pioneer in alternative

agricultural reasearch. (Wink, 1984, p. 14)

(2) Orthodox Economics

The value system which is the basis of classical economic theory assumes that people pursuing private self- interests will somehow result in the best of all possible worlds. In effect, it elevates greed and downplays more sustainable character traits of human behavior. The rationality of this economic theory from eighteenth century England is increasingly being questioned:

> ...[I]n today's world it is excessively competitive and overrewards greed, selfishness, pride, and aggressive, irresponsible behavior. Economic theory does not acknowledge that people are also generous, cooperative, and altruistic, since this behavior is unpaid and omitted from the GNP. (Henderson, 1981, p. 63)

Henderson also observed that at least four of the seven deadly sins of medieval Christianity are openly encouraged by the free market system--pride, envy, avarice, and gluttony. Johnson argued the other three deadly sins-- anger, sloth, and lechery--may have some relation to the market economy as well. (1978, p. 130)

The "invisible hand" directing the market economy is tantamount to greed. The self-interests which drive the market are leading industrial society on a collision course with finite resources and pollution. In its outcome, Stavrianos argued, "A consumer-oriented society is self- destructive psychologically as well as ecologically." (1976, p. 138) It's been argued that the "invisible hand" of economics is an "invisible foot" trampling on social and ecological systems. (Henderson, 1981, p. 81)

Fromm argued that we live in an age of "radical hedonism" in which economic theory preaches "that egotism, selfishness, and greed, as the system needs to generate them in order to function, lead to harmony and peace." (1976, p. 3) Similarly, in his critique of orthodox economics,

Schumacher warned that by inflating the role of greed as the driving force in social relations, self-destructive behavior becomes the rule rather than the exception:

> If human vices such as greed and envy are systematically cultivated, the inevitable result is nothing less than a collapse of intelligence. A man driven by greed loses the power of seeing things as they are, of seeing things in their roundness, and his very successes become failures. (1973, p. 29)

Economics is the study of how scarce resources can best be allocated to satisfy human needs. By this definition, the prices and use patterns for nonrenewable resources should reflect the long-term costs of current depletion. Dominant economic theories in North America, however, continue to use the short-term market price for nonrenewable resources, thus promoting inordinate consumption in the short-term. In effect, orthodox economic theory accepts the satisfaction of short-term human greeds at the expense the environment and future generations.

Taking a short-term, social Darwinist perspective, many economists suggest that aid to farmers who are in debt corrupts the "free market" economic system. Debt-ridden farmers are then forced into pushing the land to its limits in order to maximize short-term return. Bentley and Leskiw argued that this short-term market orientation of orthodox economic theory is a major contributing factor toward soil degradation, observing that:

> A major part of the problem with respect to current soil degradation and land misuse relates to a market-place which is very much oriented to the short run. Economics is not adept at valuing the future. (1985, p. vi-vii)

By creating economic environments which force farmers into a short-term perspective leading to soil degradation, future generations are short-changed. Schumacher chided orthodox economists for their lack of concern for future generations. He suggested that, "they give

vastly more weight to the short than to the long term, because in the long term, as Keynes put it with cheerful brutality, we are all dead."(1973,p.41)

This lack of relation between economic theory and future generations is stated more generally by Rifkin. He argued that, "It should be understood that there is no way to allow for the needs of future generations in classical economic theory."(1980,p.137) Cobb added that:

> As long as our economic theory is grounded in the models that underlie conventional agricultural practice, that practice will be favored. This favoring will not be only theoretical, since national policies and business practices will reflect a model that is uncongenial to ecological farming and places roadblocks in its way. We cannot solve the problem of sustainability in agriculture without looking at the fundamental assumptions on which other aspects of our corporate life are based. (1984,pp.209-210)

(3) Governmental Entities

Governments have tended to push for maximum short-term farm output in order to maximize revenues. This has happened in Western Canada, where Rowe argued that, "Government policy right from the start was production for export; an industrial bias was built into the food system from the very beginning of western agriculture."(1984,p.53) Similarly, in the U.S. in the early 1980s, Clifton observed that, "Current national agricultural policy strongly favors increased agriculture production."(1982,p.16) Agricultural revenues have been used to finance armies, to fuel industrial expansion, and to meet balance of trade deficits.

The push for maximum agricultural production leads to either more intensive practices or more extensive practices, or both. More intensive practices entail higher inputs and less rest for the land. More extensive practices entail farming land that is marginal and should not be cultivated. Both sources of greater output result in

adverse environmental consequences when continued over an extended period of time. (Borrelli, 1984, p. 22; Alden, et al., 1984, p. 43; Clifton, et al., 1982)

The desire for political contributions has also affected decisions on agricultural policy. As the input and output industries in the agribusiness sector grow, they assert growing levels of influence on the political system in the form of political contributions. As a result, industrial and urban interests increasingly dominate biological and rural interests. Fukuoka explained that:

> ...the modern agricultural policy-makers depend on large capital investment in fertilizer and agricultural machinery for their base of power. To do away with machinery and chemicals would bring about a complete change in the economic and social structures. (1978, p. 81)

Public policy in North America has tended to encourage the private interests in land speculation. As Buttel explained, "Among the developed capitalist societies, the United States stands out as the only nation that has no state control over the private market in agricultural or rural land." (1983, pp. 116-117) Contrasting the land situation in the U.S. with that in European countries, Buttel observed that:

> Unfortunately, little public attention seems to be focused on the land market and how it might be controlled in the interest of small- and moderate-scale farmers and the majority of the nonfarm population. In contrast, several European countries have established mechanisms that provide the state with veto power over land transactions other than intergenerational ones. (1983, p. 117)

The absence of laws protecting agricultural lands from speculators reflects the domination of private self-interest in U.S. society. The political system reflects this value orientation and resists perspectives on the treatment of land which would enhance long-term agricultural sustainability.

(4) Corporate Interests

Agricultural development has been motivated less by technological

considerations and a concern for long-term ecological and social health than by the drive for power and profits. (Stavrianos, 1976, p. 64) As was argued earlier, the public agricultural research community has been tied into the corporate industrial approach to agriculture as well. Stavrianos argued that, "Large corporations are also virtually the sole beneficiaries of agricultural research financed by the federal, state, and county governments." (1976, p. 35)

In a recent critique of the values of corporate agriculture, Friedland (1984) discussed the danger posed by short-term private interest as the main driving force in modern industrial society. Because of the power of vested corporate interests, government efforts to protect the environment and human concerns are severely weakened.

That the lion's share of benefits within the current food system go to private corporate interests can be seen in the fact that, according to the USDA, for every dollar the American consumer spent on food in 1980, marketing and processing companies took 69 cents, farm suppliers drew 27 cents, and farmers got four cents. Zwerdling noted:

> Powerful agribusiness oligopolies decide how much farmers pay for seed, feed, chemicals, and equipment. A few multinational marketing companies determine the return farmers receive for their products; because the individual farmer is small in relation to the market, it is the buyer, not the seller, who sets prices. The banks, meanwhile, determine the cost and availability of credit. (1983, p. 23)

The overpowering interests of corporate agribusiness over the family farm in public research can be seen in the development of hybrid corn seeds. Kloppenburg argued that when the U.S. agricultural research community was mobilized with public funds to develop higher-yielding seeds through the 1940s and 1950s, hybridization was not the only productive approach to corn improvement available. Hybrid seed research, however, won out in the end. As a result, farmers became annually dependent on corporate seed suppliers for hybrids,

despite the fact that:

> Agronomists of the time widely opposed the shifting research orientation. Lewontin (1982) and Berlan (1982) have argued convincingly that yield gains similar to or better than those of hybrids could have been achieve in open-pollinated varieties via population-selection techniques. (Kloppenburg, 1984, p. 300)

Environmental impact analysis has been one of the tools available to government to control negative ecological impacts resulting from current trends toward large-scale corporate agriculture. As was explained in the section on governmental values, however, corporate interests have been able to compromise efforts to protect the environment.

In the chemical industry, for example, there are economic incentives to develop broad-spectrum pesticides. While selective agents are usually more ecologically sound, they take longer to develop and are more commercially risky. Though broad-based pesticides are more likely to cause ecological damage, Davis argued that chemical companies tend to ask, "Why should they change [from a broad-based pesticide] if it is more profitable not to change?" (Davis, 1984, p. 162)

Unless the value orientations of corporate interests are shifted from greed toward a concern for ecological and social need, social impact analysis is likely to face similar obstacles as environmental impact analysis. As Friedland explained:

> Unless we start thinking in terms of how you make a transition from the kind of rampant, private incentives which exist in our society, and how they can be brought under control-- and routed back towards the grass roots with genuine popular participation, SIA [Social Impact Analysis] turns into the same thing as an environmental impact assessment. (1984, p. 336)

(C) The Metropollyanna Value: The Urban Bias

This is the value-based assumption that it is inevitable and even desirable that the rural population will eventually move to the cities, leaving the farms to large corporate agribusinesses. It is an

assumption which rejects the prospects of a balanced rural society, as put forth in various Western European models. (Meier and Brown, 1983, p. 54) Under the spell of this value, nations pride themselves on how few people remain in farming. (Rowe, 1984, p. 55)

An organization named Rural America labeled this value assumption "metropollyanna" and presented monthly awards for outstanding examples of its use in public discourse. A typical example of this value-laden assumption in practice can be seen in a Rand Corporation study of rural-urban migration in the U.S. which asserted that:

> The American economy and way of life, for better or worse, will continue to become metropolitan... Attempting to revitalize many rural areas is to linger nostalgically on an era that has passed; trying to consolidate what remains is to prepare realistically for the metropolitan future ahead. (Morrison, 1972, pp. 10-11)

Adherents of this urban industrial value tend to view the social and ecological breakdowns in rural areas as part of an inevitable, and even desirable, outcome. (Bentley and Leskiw, 1985, p. vii; Schumacher, 1973, p. 64) With the depopulation of rural areas, however, there are high social and ecological costs. With increasing proportions of humanity cut off from contact with the land and other life forms, urban populations have tended to be unsympathetic with the needs of the land and the farmers. (Rowe, 1984, p. 54) The result is an increasingly "harsh and improvident treatment of things upon which we ultimately depend, such as water and trees." (Schumacher, 1973, p. 56) Agribusiness is primarily concerned with highly specialized phenomena within the context of the urban market economy.

Many critics have argued that cities tend to be exploitative by nature. (Rowe, 1984, p. 55) Rifkin argued that the infrastructure of industrial, urbanized society is specifically designed to maximize energy flow, making the reverse goal of conservation within this

high-energy infrastructure a mere palliative. (1980, p. 119) For example, "The careless way in which urbanized man diverts his stream of nutrients is a major cause of present environmental troubles." (Hicks, 1975, p. 24) Not only does the flow of vital nutrients deplete the soil, the flow of wastes from cities pollute waterways. In Rifkin's words, "The sober truth is that we can no longer afford to maintain these incredibly entropic urban environments." (1980, p. 151)

Fueled by the metropollyanna value assumption, cities use their numerical, political, and economic clout to deter careful husbandry of the land. The responsibility for maintaining the renewable resource base of agriculture has been abandoned for the extractive industrial processes of agribusiness. (Rowe, 1984, p. 55) In this transition, the values of an agrarian society are being lost. Borsodi described those disappearing land-based values:

> They are immeasurably important values: touching something very deep in the life of man. When we lose our capacity for enjoying them; when we are unable to take these basic cravings of the race and dignify and elevate them into a form of artistic expression, we lose a part of our inheritance as human beings. (Borsodi, 1929, p. 338)

(1) The Agricultural Sciences

A value assumption of some agriscientists is that there is one inevitable course for agricultural development (concentration of capital, increase in the size of farms, decrease in the number of farms) which yields the greatest level of societal benefits (through increased production efficiencies). (Berardi, 1984, p. 18) The belief in the inevitability of an increasingly urban future results in a detachment from concern for the rural environment and social structure. Industrial technologies create changes which the ecological and social systems of agriculture are forced to adapt in order to survive.

There has been a long and continuing urban bias in North American

universities. For example, while over 130 U.S. colleges and universities offered programs in urban studies in 1984, there was no integrated program in any state university where a person could major in rural studies and develop a comprehensive and in-depth grasp of ecological and social issues in rural areas. (Freudenberger, 1984, p. 70) In Canada, McGill charged that despite the importance of soil resources to Alberta and to the country, "our educational system ignores them. Again, this is controlled by the urban conscience. The urban community needs to know, your children need to know, and everyone needs to care." (1985, p. 191) Buttel and Newby added that:

> Rural sociology has been very badly served by the classical writers in the history of sociological thought who, in their endeavor to create theories of urban-industrial society have all too often misunderstood or even ignored the nature of rural society. (Buttel and Newby, 1980, p. 4)

Durkheim, for example, viewed humanity as being separate and above nature. His classical conception of the organization of modern industrial society, which he described as "organic solidarity," treated the biophysical environment as a factor to be conquered by human progress. He saw humanity as being in a virtual state of war with nature, arguing that, "To fight against nature we need more vigorous faculties and more productive strengths." (Durkheim, 1893, p. 42) Urban industrial societies have often taken up Durkheim's battle cry against nature with a vengeance in the structures and practices of agriculture.

Theories of development based on taxing rural agricultural resources in order to build urban industrial societies continue to be taught in universities across North America. Students from all over the world are, in this way, presented the theory of urban industrial exploitation of rural people and the rural land base as a theory of development. This conception of development tends to promote a

predatory, colonizing attitude and value system globally. It, in turn, increases the potential for future wars over resources being depleted by industrial practices.

Critics of the urban industrial bias of the agrisciences have been speaking out long and hard. In the 1920s, Borsodi accused public research institutions in the U.S. of "deliberately commercializing and industrializing agriculture." He argued that universities and governments subordinated "the real interests of agriculture" to that of the fertilizer, canning, milk-distributing, meat-packing, automotive and petroleum, "and all the other industries and industry interests, which prosper upon a commercialized agriculture."(Jackson, 1980, p. 104)

The Land Grant College System in the U.S. may have been a well-intentioned attempt to benefit farmers and rural areas. But as Friedland explained, it is "the system which probably contributed more than any other factor to the absolute annihilation of the population in agriculture."(1984, p. 336) Within this system, "efficiency" considerations have usually been geared toward capital intensity and economic concentration. This definition of effeciency has worked against the family farm and rural communities. Hightower argued that:

> Land grant college research for rural people and places is a sham. Despite occasional expressions of concern from land grant spokesmen, a look at the budgets and research reports makes clear that there is no intention of doing anything about the ravages of the agricultural revolution. The focus will continue to be on corporate efficiency and technological gadgetry. (Buttel and Newby, 1980, p. 12)

The research priorities of industrial agriculture have resulted in a narrow range of production-technology options from which farmers can choose. For the diversity inherent in natural systems, "orthodox agriculture has substituted a dull, tight uniformity, not only ignorant of other possibilities, but scared of them, and vengeful in its ignorance."(Berry, 1977, p. 180) Berardi explained that:

> These options reflect the specific value systems of research institutions, land-grant colleges, and private firms, for whom family farms, farm communities, and environmental well-being are often secondary concerns. (Berardi and Geisler, 1984, p. 8)

Larson and Rogers(1964), themselves rural sociologists, viewed the depopulation of the American countryside as a sign of progress. They belittled those farmers who did not accept or could not afford new agribusiness technologies as "laggards." To add insult to injury, they called the farmers forced off their land "dropouts."(Larson and Rogers, 1964, p. 46) In their analysis, they failed to mention the problems of human suffering, rural and small town decay, urban overcrowding, increased crime, farmland suburbanization, and other destabilizing and threatening impacts of excessive depopulation of the American countryside. They accused supporters of more sustainable approaches to agriculture such as organic farming and crop rotation systems of lacking "economic rationality" and lacking in "empathy or open-mindedness toward new roles."(Larson and Rogers, 1964, p. 46)

As a result of its value structure, "the agricultural establishment has simply looked away from the possibility of an economics and a technology suited to the needs and aims of the small farmer."(Berry, 1977, p. 76) When the long-term social and environmental costs of the massive rural-to-urban migration in the United States are totalled up, however, it is likely that the agricultural industrialization patterns which Larson and Rogers supported will be the ones shown to be lacking in "economic rationality" and "empathy and open- mindedness."

(2) Orthodox Economics

Rowe has argued that most economists reflect the urban bias of industrial society. He explained that, "Agriculture is encouraged to become industrial farming because, by and large, city people perceive

an advantage in it going that way, and they make this the economic path of least resistance."(Rowe,1984,p.54) Clearly urban agricultural priorities include such things as cheap food; maximum sales of agricultural inputs such as farm machinery, chemicals, and fossil fuels; and maximum exportable surpluses to balance the trade deficit based on the import of chemicals, fossil fuels, and the raw materials needed to manufacture farm machinery. All these urban priorities tend to work against the health of rural areas.

The social Darwinist value assumptions prevalent among many economists contributes to the decline of rural areas and the overcrowding of urban areas. Their "survival of the fittest" slogans tend to translate into a "survival of the biggest and wealthiest" reality in agricultural development. In the absence of a value structure promoting ecological and social health in agriculture, farmers are forced into getting bigger or leaving.

Buttel noted that, "the private market in agricultural land is perhaps the key force that augments the 'treadmill of technology' (Cochrane,1979)"(1983,p.117). In this treadmill of ever bigger farms and ever bigger machinery, small producers are being marginalized and forced out of agriculture, even though they have been shown to be among the most productive. Out of a concern for the health of farmers, rural communities, urban centers, and international peace, Knapp argued that:

> Through ignoring or insufficiently taking into account the foundations of the community, which are to be found in agriculture, even economists and statesmen of repute often fail to form a true idea of the consequences attendant on a number of drastic measures, for example of a social character. In consequence of this, many fail to regard from the correct angle the various important economic problems, such as those dealing with population, unemployment and wages, which disturb modern society.(Knapp,1935,p.9)

Obviously, not all economists are contributing to the problems in North American agriculture. Schumacher, Boulding, and Heilbroner are

among the many economists who have sought sustainable alternatives. Unfortunately, their alternative perspectiyes remain at the fringe of the mainstream orthodox economics.

(3) Governmental Entities

The United States and Canada are democratic societies with power bases increasingly urban and industrial. Corporate agribusiness interests have lobbied hard and worked closeby with government officials to protect and enlarge their interests. As Vogeler pointed out, they have not stopped short of claiming to help the family farm while actively subverting its interests. The benefits of land grants, tax laws, land grant college research and services, and other farm programs have gone inordinately to the large-scale producer. (Hightower, 1973) Vogeler argued that:

> Under the cover of supporting family farmers, agribusiness and federal policies are actually destroying family farms and replacing them with artificially created large-scale producers. Consequently, in 1974, 153,122 farms or 6.6 percent of all farms produced 53.8 percent of the total value of agricultural products. (1981, p. 4)

The Payment-In-Kind (PIK) program in the U.S. was an excellent example of a program which was supposed to help the family farm but actually strengthened the large-scale corporate farm. The PIK program gave farmers 80 percent of the crops they produced previously in exchange for keeping the land idle. By basing PIK benefits on how much had been produced on the land in the past, the more intensive farms received more free crops per idle acre than farmers with lower-input systems such as crop rotation systems. Small, mixed crop farms were penalized. For instance, farmers who grew their own feed for their livestock had no reason to participate in PIK because they needed all their crop--not just the 80 percent promised by PIK.

Despite high expectations for the PIK program, it wound up

"benefiting the rich at the taxpayers' expense."(Braine, 1984, pp.78-79) In 1983, for example, a General Accounting Office survey determined that 15 giant farm conglomerates received a total of $23 million worth of crops from the Federal government in exchange for not planting crops. (Braine,1984,pp.78-79)

The USDA has recognized the government's role in exacerbating some agricultural problems, admitting that:

> Most of the income benefits from traditional commodity programs...go to the largest producers. Our tax laws have favored larger operations and encouraged outside investment in agriculture. And our credit system may well have fostered a kind of economic cannibalism within agriculture by giving aggressive operators the means to buy out their neighbors. (USDA,1979,p.1)

Clearly, U.S. government officials are aware that governmental programs are creating additional problems in agriculture, but so far, they have been unable to correct the situation. Buttel argued that government "lacks the leverage necessary to reverse these changes in the interest of resource conservation or other social goals."(Buttel, 1984,pp.96-99) As a result, public agricultural policy has tended to contribute to agricultural resource management problems.

(4) Corporate Interests

Family farmers increasingly find themselves in competition with farms owned by big agribusiness concerns. Such corporate farms may be part of vertically integrated companies which can make up crop losses in processing or retailing food or may be part of a non-agricultural company that can reduce its taxes by writing farm losses off against profits from unrelated enterprises. (Zwerdling,1983,p.23)

The political power gained as a result of increasing corporate size was discussed earlier. Because of the predatory values of corporate enterprise, family farms have little chance of survival in the long run. As Zwerdling explained, "Isolated and largely

unorganized, farmers are being ripped off by corporations at almost every step of the process--on the farm, at the market, and in the lending institution."(1983,p.23)

Large industrialized agricultural firms are able to profit through a process of internalizing benefits by externalizing certain costs. The disadvantages of large scale operation, such as the deterioration of rural social structures and tax bases and increased pollution, fall largely outside the decision-making framework of the large farm firm. In testimony before the Subcommittee on Monopoly of the U.S. Senate Small Business Committee, P. Raup, professor of agricultural economics at the University of Minnesota, explained that:

> In theory, large-scale operation should enable the firm to bring a wide range of both benefits and costs within its internal decision-making framework. In practice, the economic and political power that accompanies large size provides a constant temptation to the large firm to take the benefits and pass on the costs. (Berry, 1977, pp. 171-2)

The 1920s were a rich period for social criticism of corporate industrial agriculture, with Borsodi and a group called the Vanderbilt Agrarians leading the way. Borsodi was critical of the values of corporate industrial society. He argued that man wastes and pollutes "not because this is the wisest use he can make of his time but merely in order that he may keep his factories busy and make the money with which to buy what they produce."(Borsodi, 1929, p. 351)

The Vanderbilt Agrarians shared similar concerns about the urban industrial society and its effects on agrarian society. Their history is described in a recent compilation entitled A Band of Prophets. In a review of that book, Lears argued that the contributing authors:

> All grasp the central irony of contemporary cultural debate: that corporate capitalists are the chief enemies of the traditional values they claim to defend. In the writings of these thinkers, one can sense a dawning realization that loyalties to family, community or faith are not mere relics of an Age of Superstition; they can provide important resources for resisting the atomizing effects of

ceaseless 'growth.' (Lears, 1982, p. 53)

In this chapter, it has been demonstrated that the mechanistic value, the short-term private interest value, and the urban bias which direct agricultural development are obstacles to developing more sustainable agricultural systems. Until there is a redirection of these prevalent values of urban industrial society, the ecological and social breakdown of North American agriculture is likely to continue.

CHAPTER VI

VALUES FOR A REGENERATIVE PARADIGM

Past civilizations have had difficulty averting agricultural disaster when it implied the need to change values and assumptions which led to their crises. Referring to the Mayans, the Romans, and other past civilizations, L. Brown said, "their value system did not adapt in time to turn the new information into new values, priorities and programs."(1981, pp. 349-50)

In hopes of averting an agricultural collapse similar to those of past civilizations, supporters of a regenerative paradigm for agriculture are outlining a set of values which could encourage a more sustainable course for agriculture in North America. After more than four decades of increasingly intensive agricultural practices, North Americans are beginning to recognize that environmental problems in agriculture are serious and need to be dealt with. Without the collective will to act in a responsible manner, "the needed shifts in priorities, programs, and funds are not likely to materialize." (L. Brown, 1981, pp. 165-6) This chapter identifies an emerging social movement for a regenerative paradigm for agriculture and outlines an emerging set of values.

A. Emergence of a Regenerative Agriculture Movement

Social movements are conscious, purposeful attempts to bring about change. (Wilson, 1973, p. 11) In the sociological literature, three conditions are identified as common to successful social movements: (1) mass dissatisfaction focused upon some group, institution, or symbol of a menace; (2) a tolerance of alternative viewpoints within society; and (3) effective leadership and organization within the particular

movement. (Green in Bertrand, 1958, pp. 349-350) An analysis of recent trends in North American agriculture from the perspective of these three criteria suggest that a broad-based social movement is forming to encourage changes in the structure and practice of agriculture.

(1) Mass dissatisfaction focused on an institution-- Beginning with Carson's The Silent Spring and continuing through the oil crisis of the mid-1970s and recent droughts, concern has grown over the long-term sustainability of industrial agriculture as it is commonly practiced in North America. In the span of just a few years, awareness of the precarious prospects for the long-term sustainability of industrial agriculture has grown from being the concern f strident fringe elements to the source of widespread mobilization and action.

As a wide range of social and ecological problems have appeared in areas where agriculture had been industrialized, growing dissatisfaction has been focused upon what Youngberg referred to as conventional agriculture. By **conventional agriculture**, he referred to the prevailing industrial mode of agricultural production:

> ...with its heavy reliance upon synthetic chemical fertilizers and pesticides, large-scale, expensive mechanization, nonrenewable fossil fuels, and its trend toward ever larger farm units, especially the huge corporate farming operations which have emerged in recent years. (Youngberg, 1984, pp. 107-108)

Conventional agriculture, or industrial agriculture as it is referred to in this study, is being increasingly challenged on four major fronts:

a. the depletion of natural resources such as topsoil, fossil fuels, and the genetic diversity of nature;

b. the agricultural pollution of water systems, the air, and wildlife areas;

c. the displacement of the farm population, mostly from small and

medium-sized farms; and

d. the presence of toxic agrichemical residues in foods.

In the United States, a large and growing number of consumer groups, farm organizations, research and advocacy centers, university researchers, and authors of articles and books are challenging industrial agriculture on one or any number of these fronts. Expressions of this growing concern have included the Catholic Bishops' letter on "Food and Agriculture," a National Food Marketing Institute Survey indicating a high level of consumer concern about toxic substances in food, formation of national groups like "Americans for Safe Food," formation of the state-sponsored Committee for the Sustainability of California Agriculture, and the establishment of sustainable agriculture programs in 19 U.S. universities where there were none as recent as 1983. (Wisconsin Rural Development Center, 1986) A common thread woven through these group actions is a concern over the long-term sustainability of agriculture.

Similarly, in Canada, there is growing concern for the long-term sustainability of agriculture. This has been demonstrated by the recent formation of groups like the Sustainable Agriculture Association of Alberta, an on-going program on agricultural sustainability at McGill University, and a number of reports such as "Directions for Sustainable Agriculture,' published by the Ontario Institute of Agrologists.

(2) A tolerance of alternative viewpoints within society--By definition, social movements use noninstitutional means in their attempt to bring about or resist large-scale change in the social order. (Green in Bertrand, 1958, pp349-350) As with other social

movements, there are some essentially noninstitutional perspectives in the movement for agricultural sustainability which, by definition, are not yet "widely accepted as binding in society or part of society."(Wilson, 1973, p. 9) As a result of the growing awareness of the crises facing North American agriculture, however, tolerance of these noninstitutional perspectives has been increasing.

What began as the protestations of a few individuals and groups on the fringe of agriculture has become a concern of the agricultural establishment, which Paarlberg defined as, "The farm organizations, the agricultural committees of the Congress, the Department of Agriculture, and the Land Grant Colleges."(Paarlberg in Youngberg, 1984, p. 107) With a flurry of recent governmental reports, policy initiatives, and university programs geared toward the issue of agricultural sustainability, the issue has gained increasing credibility. This has opened up opportunities for greater acceptance of alternative viewpoints.

Concern over soil erosion trends in the United States has led to the passage of the Soil and Water Resources Conservation Act of 1977 and the Food Security Act of 1985. The 1977 act called for a detailed survey of the condition of U.S. soils in which soil scientists discovered "alarmingly high" rates of erosion by water in many areas. The 1985 act included major conservation compliance, sodbuster, swampbuster, and conservation reserve program components. (Durban, 1987, p. 70)

Similarly in Canada, four major governmental studies since 1983 have warned about the gravity of the soil degradation problem. First, the Prairie Farmland Rehabilitation Administration report in 1983

presented evidence of soil erosion on the prairie. Second, the Senate Committee on Agriculture Fisheries and Forests released "Soil at Risk" in 1984. In 1985, a third major report was issued, this time by the Department of the Environment, saying that soils have degenerated in all parts of Canada, costing farmers about $1-billion a year. Most recently, Bentley and Leskiw's report for the Environmental Council of Canada in 1985 became the fourth national report in as many years to warn of soil problems. A passage in that report illustrates the growing concern about sustainability:

> The concerns of soil scientists about the sustainability of the productivity of agricultural lands in Canada have increased sharply in recent years. That is clearly reflected by the themes and topics of annual provincial soil science workshops since 1975. As one soil scientist said in February 1983: 'Five years ago no one was talking about soil degradation; now everyone is concerned about it.' (1985, p. 15)

(3) Effective leadership and organization within the movement--Though the movement for agricultural sustainability is essentially a diverse and broad-based grassroots movement representing a wide range of specific agendas for agriculture, it is argued in this thesis that the Rodale organization in Emmaus, Pennsylvania stands out as the most effective leader. Four basic reasons contribute to this argument.

First, Rodale stands out as a leader on the basis of longevity. The organization has been sponsoring alternative agricultural research and publications for over forty years. No other alternative agriculture group in North America has maintained its efforts for such a long period of time.

Second, its growing size and public visibility puts it in a leadership position. Rodale Press now employs over 800 people and publishes numerous books and magazines which reach over ten million

people a year.

Third, the Rodale agenda for agriculture is as broad-based in its concerns as are the concerns of the overall sustainable agriculture movement itself. Rodale's publications and research activities range from concerns for the agricultural resource base (i.e., Pay Dirt, by J.I. Rodale), to the health of agricultural ecosystems (i.e., the Rodale Research Center), to the financial well-being of the farm population and rural communities (i.e., *The New Farm* and *Regeneration* magazines), to the health of individuals (i.e., *Prevention* magazine).

Fourth, and most important to this study of agricultural paradigms, Rodale provides the movement for agricultural sustainability with its leading noninstitutional perspective, the Rodale concept of **regeneration**. Though many other labels have been applied to this movement, such as "alternative" agriculture, "sustainable" agriculture, "ecological" agriculture, and "low-input" agriculture, it is argued in this thesis that the concept of "regenerative" agriculture best incorporates the breadth of scope necessary for a paradigm-level analysis. **Regeneration** refers not only to an alternative approach to agriculture, but to an alternative approach to community development, an alternative approach to problem- solving, and an alternative worldview to that common in modern industrial society. In this thesis, it serves as the defining label for the sustainable agriculture movement (i.e., the regenerative agriculture movement). It describes an alternative scientific paradigm to the dominant industrial paradigm for agriculture.

B. Regenerative Values

The regenerative paradigm provides an alternative set of values to

counter the three major value orientations of the industrial paradigm outlined in Chapter V. First, the merits of an ecological/holistic value orientation are compared to those of the prevailing industrial/mechanistic value orientation. Second, the value of designing agricultural systems to meet social and ecological needs is contrasted with the prevailing tendency to base agricultural decisions on short-term private interests. Finally, the principle of a balanced human/land ratio through potential rural resettlement is compared to the urban bias of the metropollyanna value.

(1) From a Mechanistic to an Ecological Value Orientation

There are numerous eloquent pleas for a more ecological understanding of and harmonious relations with the agricultural environment. (L. Brown, 1981, p. 352; Freudenberger, 1984, pp. 98-99; Gardner, 1982, p. 20; Henderson, 1981, p. 411; Heilbroner, 1974, p. 94; and Rifkin, 1980, p. 68) These and other analysts have argued that problems in agriculture must be seen from a broad contextual perspective. The Canadian report entitled Soil at Risk(1984), for example, explained that, "Soil conservation cannot be dealt with in isolation from related issues such as water quality, land use, wildlife management, fisheries and forestry." Bentley and Leskiw identified even broader connections, saying:

> Nor can soil conservation be separated from the contributions of good husbandry and stewardship made by those who wish to live on, and farm the land. Is it a coincidence that future prospects for both the soil and the rural family are endangered? It is also questionable if the family farm can survive without the concurrent survival of the rural community. (1985, p. vi)

As argued in Chapter V, the agricultural sciences in North America have placed a high value on an industrial/mechanistic world view.

Though this mechanistic way of seeing the world has been highly successful in achieving the goals of short-term profitability and engineering feasibility, this study has documented a series of chronic ecological and social problems arising from industrial practices and structures.

Scientific inquiry is essential for the improvement of agriculture, but critics of the prevailing mechanistic worldview have asked whether the agricultural sciences have been oriented in a socially and ecologically sustainable direction. (Schumacher, 1973, p. 134) They argue that a holistic assessment of agriculture's role in society has seldom taken place, in large part, because of the overspecialized, reductionist approach of science based on the mechanistic world view. As Gardner observed, "We know how to do things efficiently, fast and cheap. But we have lost the discipline to make provision for the consequences of what we do." (1982, p. 20)

In the process of reconceptualizing agricultural economics, it should be remembered that economics is a social science. It is, moreover, a study of living systems, and should therefore follow ecological rules as often as it follows mechanical rules. Economics and ecology share the common prefix "eco" because they both deal with the concept of general equilibrium. Environmental resistances should prohibit things from going too far in one direction. Orthodox economics, however, by following mechanical and mathematical models to excess, have tended to get away from the notions of ecological and social equilibrium.

Whereas the mechanistic worldview judges the value of land only according to what people are prepared to pay for it, the ecological way

of thinking sees land as a living community which people can either degrade or help to build up. (Thompson and Schuering, 1984, p. 160) As Cobb explained, in the ecological context, the value of land "is in the life it contains and in its capacity to contribute richness to living experience." (Cobb, 1984, p. 212)

Newton's model of a mechanical world in which the ultimate level of reality is simply matter in motion has many valuable applications in science. Cobb has argued, however, that through Einsteinian physics, we have found that "the ecological model works better for the component parts of the atom than does the mechanistic model." (1984, p. 211) Moreover, we are increasingly recognizing the importance of relational patterns in other areas of the physical world. In agriculture, which is fundamentally a complex series of living systems, the appropriateness of an ecological rather than a mechanical world view is even more profound. (Cobb, 1984, p. 211)

Miller, in his living systems theory, recognized the problems that result when complex, ecological phenomenon are simplified inappropriately, as in their being reduced to mechanical relationships. He explained that:

> The chosen parameters and variables and the hardened categories may have no known relationships to other conceptual spaces. There are conceptual gaps. Science, as a responsible social activity--as a total system-- connects and integrates all this. Collective science must submit to the imperative to fill in the gaps for integration. (Miller, 1978, p. 1051)

An ecological world view which recognizes the importance of entropy is a scientifically sound alternative to the current mechanical-reductionist world view. Entropy helps explain in a holistic way how the world works and helps us understand what we must do to survive in the long- term. Rifkin argued that:

The Entropy Law will soon supercede Newtonian mechanics as the

> ruling paradigm of science because it, and only it, adequately explains the nature of change, its direction, and the interconnectedness of all things within that change process. (Rifkin, 1980, p. 225)

From an regenerative viewpoint, the goals of a healthy agriculture tend to be better served by an ecological perspective than by the mechanistic world view which is predominant today. (Berry, 1977, p. 89) The key to a transition of world views is in the process of viewing agriculture as a multi-level living system driven to higher levels of organization by health.

Thoreau was an early advocate for using nature, rather than a factory, as the model for agricultural development. He argued, "Would it not be well to consult with Nature at the outset, for she is the most extensive and experienced planter of us all." Similarly, the British agriculturalist Sir Albert Howard argued that nature serves as an ideal model for agriculture since the forces of growth and decay are in balance there. (Howard, 1947) Humans may be able to create a similar balance in their agricultural environments; in their management of water, soil, and nutrients.

With an ecological/holistic value orientation, the soil can be viewed as a complex biotic community rather than merely as a base for industrial production. Soil is the base from which the biological process of succession takes place at all levels of biological orgranization. In this process, living systems move from a juvenile stage to a mature stage to eventual senescence and death. (Jackson, 1984, p. 170) Advocates of a regenerative paradigm argue that in pre-historic nature, the composting of living systems of the past provided the organic soil base for future evolution of life. Modern industrial agriculture has fought the process of succession and in the

process is destroying the soil base of future life. Jackson complained that there is a short-sightedness at the core of this approach to agricultural development:

> A profound truth has escaped us. Soil is a placenta or matrix, a living organism which is larger than the life it supports...But it is itself now dying. It is a death that is utterly senseless, and portends our own. In nature the wounded placenta heals through plant succession; enterprising species cover wounds quickly. (1980, p. 14)

Against the current toward specialization and reductionism of science in the modern industrial world, Cobb called for greater application of ecological, holistic principles to a wider range of studies and living situations. The application of ecological thought is seen as an essential ingredient toward the emergence of a more sustainable society. He argued that:

> The extension of ecological thinking from physics to biology, sociology, economics, philosophy, and theology needs to accompany changes in value-formation, life-styles, public policy, and religious faith. Without these changes we will be condemned to continue the pursuit of unsustainable goals. (Cobb, 1984, p. 212)

(2) From Valuing Short-Term Private Interests to Long-Term Public Needs as the Driving Force in Development

Materialist greed has long been condemned by such spiritual guides as Jesus, Buddha, Lao-Tse, and others on moral grounds (L. Brown, 1981, pp. 351-2). In modern industrial society, however, it has long been acceptable to put the teachings of profits ahead of those of prophets. The question of why the United States, with 1/18th of the world's population should be using up 1/3 of the present world production of irreplaceable fossil fuel energy in a wasteful way has seldom been asked in the mainstream of North American thought. (Green, 1978, p. 165)

It has only been in recent decades that the challenge to

materialism has also come from physical pragmatists on the grounds of entropy considerations. It is now argued that if the quest for prosperity is as insatiable as classical economic theory would have us believe, then we are on an unsustainable course. First of all, there are not enough resources to go around and, secondly, it is not likely that the environment can sustain the growing levels of pollution generated by the system. Material progress is increasingly seen as a harmful illusion that exchanges sanity and wholeness for less important physical improvements. (Polsgrove, 1984, p. 25; Toole, 1976, p. 17)

The challenge presented by the Law of Entropy is to minimize society's flow of energy to that amount which is necessary for survival in order to better protect the environment and to assure the availability of energy resources in the future. (Rifkin, 1980, pp. 245, 255; Georgescue-Roegen, 1984, p. 15) It is a matter of short-term economic efficiency versus long-term community efficiency. (Berry, 1977, pp. 41-2) The choice is not a quantitative issue between "growth" and "no-growth" (Martin, 1985, p. 38), but a qualitative issues of what is growing, what is declining, and what must be maintained. (Henderson, 1981, pp. 6-7)

Advocates of sustainable development have called for selective growth in things that count, not just things that can be counted. In place of the current urban industrial values of conspicuous consumption and fashion fluctuations must come new frugal and sensible attitudes. (Heilbroner, 1974, p. 94; Johnson, 1978) This process could begin when North American society collectively recognizes that continued growth of material consumption and the resulting pollution is not increasing the overall happiness and is actually robbing future generations. Dasgupta

argued that it must be understood that, "liberation lies not in 'limited' growth, but in the limitation of wants, in the lowering down of the standard of living of the few rich and powerful." (Dasgupta, 1980, p. 23)

Toynbee, Heilbroner, Stavrianos, and others have argued that a materially declining industrial society is likely to be a spiritually and morally ascending society. Social scientists are challenged to integrate the traditional moral vision of recognizing the needs of others with a pragmatic understanding of how the world really works under the Law of Entropy. Only then can we begin to creatively transform the impending ecological and social collapse of modern industrial agriculture into a brighter, more sustainable, future. (Lekachman, 1976, p. 291) The projection of positive alternatives is an essential first step in service to the "fundamental human interests in peace, economic and social well-being, human rights and ecological balance." (Falk, 1976, p. 8)

Most Western scientists agree that human nature is a "vast potentiality" shaped by environmental conditions. Critics of current values argue that a truly "civilized" society should provide a social environment which is oriented toward realizing the human potentiality for social and ecological service rather than private aggrandizement. In such an environment, it is reasonable to expect that, in time, the service ethic would come to be considered natural and in accord with human nature. Within this service orientation, "life would not need to be a 'permanent, unremitting struggle'--at least not a struggle between personal social interests and values." (Stavrianos, 1976, p. 135)

(3) From The Urban Bias of Metropollyanna to a Balanced Man/Land Ratio Through Rural Resettlement

Today's agricultural system in North America is resulting in the depopulation of farms and rural communities. The human population is being crowded into cities and is increasingly out of touch with biological and cultural roots in nature. (Berry, 1977, p. 29) Supporters of alternative development strategies argue there are substantial long-term benefits in allowing human populations to remain dispersed in small ecological farms and rural communities. Large-scale industrial agriculture distances people from the sources of food, resulting in larger investments in the transportation, warehousing, and retailing of agricultural products. (Baker and Borsodi, 1939, p. 207) The growing urban population, moreover, becomes increasingly dependent on complex transportation systems which are continuously depleting finite fossil fuels. In contrast, Cobb explained that:

> Smaller-scale cities with smaller-scale industry serving local agricultural regions appear more sustainable through social crises and in the face of the exhaustion of some resources. Dependence on distant sources for luxuries is, of course, not a serious problem. (1984, pp. 215-216)

Rifkin has argued that industrialization has speeded up the entropy process on earth. To slow down this trend, he said society must move from a "colonizing stage" of development to a "climactic stage" of development, just as mature ecosystems move toward a climactic state of successful adjustment to an environment.

In the current "colonizing stage" of human development, society is increasingly made up of large, energy-intensive centralized institutions which are rapidly consuming the earth's finite resources. (Rifkin, 1980, pp. 90-91) A "climactic stage" of development would represent a relatively stable and mature period in which the human population would be in greater balance with the environment and its resource base. People would be more evenly distributed in rural

areas and involved in smaller, decentralized institutions. (Rifkin, 1980, pp. 90-91)

Rifkin also refers to this proposed "climactic stage" as the "Solar Age," in recognition of its potential for adopting renewable energy systems. A more even distribution of the rural-urban population would optimize the potential for adoption of solar, wind, and biological energy systems by locating people where these renewable resources are more accessible. The greatly under-utilized potential of solar energy, for example, is described by Artin, who said:

> It is estimated, for instance, that all the fossil fuels available on earth, taking into account yet-undiscovered reserves, would equal the energy that reaches the earth in only four days of sunlight...Our efforts ought to be directed toward minimizing our use of our resource stock, and maximizing our use of the flow of solar radiation. (1973, p. 79)

Obstacles to a major solar conversion in North America include the urban bias and how we undervalue nonrenewable resources in our economic system. The "free market" value system is currently resulting in finite oil resources getting cheaper the faster we pump them out of the ground and deplete them. In order to better protect natural resources for future generations, Rifkin argued that, "The transition period to the Solar Age will require a complete reformulation of economic activity at every level of American society." (Rifkin, 1980, p. 196) Borsodi called for such an economic conversion in the 1920s in an effort to protect small ecological farms and rural communities from the excesses of agricultural industrialization. (1929, p. 352)

Plosgrove argued that an ecological consciousness in North America is emerging which could help create such an economic transition. It is growing out of a concern over the increasing number of environmental problems and industrial accidents. In discussing this emerging perspective, he asks a series of questions on how a climactic economic

system might be set up:

> The next step, a giant one, is to develop an economy that is consistent with that recognition. In the light of our dawning ecological consciousness, what should we make and how? How should we use our land, our water, our forests and fields? How should we use the land, water, forests and fields of other countries with which our economy is linked? To see these questions clearly, we need to ask others, even more basic: What kind of people do we want to be, and how should we spend our days?(1984, p. 25)

In summary, regenerative values include the predominance of an ecological perspective on agriculture, an emphasis on the long-term public good, and a strengthening of rural interests in the development equation. Based on these values, a series of regenerative principles and practices designed to promote greater ecological and social sustainability can be described in the chapter to follow.

CHAPTER VII

ECOLOGICAL AND SOCIAL PRINCIPLES OF THE REGENERATIVE AGRICULTURE PARADIGM

Regenerative principles are designed to prevent degradation by better "solving nature" rather than being relegated to reacting to repeated crises resulting from fundamentally unsound practices. (McGill, 1985, p. 186) Most of the regenerative practices described here involve redesigns of industrial agroecosystems. This is in keeping with Hill's concept of "deep" solutions:

> Eventually we must abandon these shallow approaches and adopt deep solutions, which demand that we redesign those parts of the system and those approaches to management that are generating the problems... In contrast to present systems, in which we perceive ourselves as separate (on the outside), in redesigned systems we would come to accept our integration into the biosphere, and much of our efforts would be devoted to maintaining balance and paying attention to feedback. (Hill, 1985, p. 34)

A noteworthy aspect of the regenerative paradigm is that the ecological practices and principles follow very closely the pattern of the social practices and principles. This is in keeping with the notion that in the living systems approach, there are crossover effects and patterns of healthy development which apply at various levels of the total system.

A. Ecological Principles and Practices

Adherence to certain regenerative principles can contribute to the long-term ecological sustainability of agricultural systems. Some of these principles are long- established ecological rules which have been set aside during the industrial age of agriculture. Schumacher recognized the need to re-establish ecological principles when he pointed out that:

> We know too much about ecology today to have any excuse for the many abuses that are currently going on in the management of the land, in the management of animals, in food storage, food processing, and in heedless urbanization. (1973, p. 108)

McGill, Rowe, Artin, Larson, Berry, Hill, and others have recommended ecological principles and practices upon which to build a more sustainable agriculture. This compilation is an attempt to incorporate all of these recommendations without repeating common principles. The principles listed here can be remembered by the acronym B.I.R.D.S.E., an abbreviation for bioregionalism, integration, return, diversification, small scale, and education.

(1) Bioregionalism

A bioregional approach to agriculture seeks to optimize the use of the soil, climate, and human resource characteristics of a particular biologically-defined region. Rather than looking simply at annual production at any ecological or social cost, the emphasis is on a resource-based system maximizing the long-term ecological and social potential of the region.

A healthy resource-based system of agriculture is sensitive to the limitations as well as the advantages of the particular resource endowment. In the bioregional approach, agricultural technologies are designed to fit the climate, the land, and its occupants, not the reverse. In the past, the application of standardized agricultural techniques has often led to social and ecological problems. For example, the exportation of techniques developed in northern zones to the tropics has led to a host of problems described in the literature on the Green Revolution. (Artin, 1973, p. 30) As Rowe argued, "If the goal is maintenance first and production second, it is obvious that one uniform technology cannot be forced onto the land." (1983-4, p. 56).

Agricultural technologies should also be in harmony with the human resources of each bioregion. Johnson explained that, "Agricultural skills [develop] in areas where long periods of habitation had

permitted the slow accumulation of ecological experience."(1978, pp. 48-49) Technologies which force farmers off the land often take away valuable ecological sensitivity gained by being in close contact with the land for long periods of time.

A healthy bioregional system contributes to a greater regional food self-sufficiency. Local replacements for imported goods are sought. Only when regional needs are satisfied are export markets considered. (Rowe, 1984, p. 56) When local goods are exported, broadened job opportunities can be created by processing raw materials locally. This emphasis on local value-added industries helps optimize the benefits from the region's unique resource characteristics. (McGill, 1985, pp. 192-193)

(2) Integrated Ecological Systems

The concept of integrated ecological systems involves the process of converting waste and pollution into productive resources by treating the land as an integral part of a biological cycle. (Hicks, 1975, p. 120) In the autumn of 1984, the first conference on sustainable agriculture and integrated farming systems ever sponsored by a U.S. land grant college was held at Michigan State University. (Wink, 1984) Interest in integrated biological systems has grown among agricultural extension specialists since that time, as indicated by a recent USDA report on work in Virginia. (USDA, 1984, p. 41)

Farmers have been finding that they are using more chemicals and getting less return. Better integration of agricultural systems can help farmers get off this agrichemical treadmill of growing dependence on fossil fuels by reducing off-the- farm and inorganic inputs. Rowe argued that, "Attention to on-farm energy efficiency, and to soil improvement by cultural methods can reduce the dependency

significantly."(1984,p.56)

It appears difficult for the modern analytical mind to comprehend or accept that an agricultural system can be made more stable and productive by imitating an ecological order "beyond our understanding by building the soil."(Berry,1977,p.85) "Primitive" cultures like those in the Andes Mountains have mastered this principle by focusing on the long-term maintenance and improvement of the sources of production. In contrast to the short-sighted priorities of much of industrial agriculture, "The themes of Andean agriculture are frugality, care, security in diversity, ecological sensitivity, correctness of scale."(Berry,1981,p.41) These themes have served Andean agriculture well for many centuries while much richer farmlands in North America are being exhausted in a few hundred years.

The ideal for the integrated system approach is to make each farm the source of its own operating energy by better utilizing the the sun, water, wind, methane, soil life, work animals, and human sources. The integration of living systems helps build ecological stability into agriculture. This is in keeping with the fundamental principle of ecology that complexity in an ecosystem helps promote stability in the system.(Artin,1973,p.26)

In the planning and management of integrated ecological systems, most components tend to serve multiple functions and are always being considered in the context of the whole.(Hill,1985,p.34) For example, the waste from one component of a system becomes the renewable fertilizer of another component. This process of agricultural integration reduces waste, reduces dependence on nonrenewable resources from outside the farm, and better utilizes locally renewable resources. In this way, the ecological integration of farms contributes toward the

goals of ecological stability and productivity within systems which regenerate themselves.

By emphasizing productivity per calorie of energy of input, the integrated systems approach places a higher premium on ecological skills than on the standard mechanical skills of industrial agriculture. There is growing recognition that these ecological skills are important to agricultural productivity. As Barnhart pointed out, "Studies of agricultural land use show that high production and good stewardship depends largely on ecological skill rather than on great energy subsidy."(Coates, 1981, p. 479)

(3) Return

Return is the principle which suggests that we should be as attentive to decay as we are to growth and as concerned with maintenance as with production. It is related to the principle of bioregionalism in that it argues for a return of non-toxic urban wastes to farmland within each particular region. The relevance of this principle to Canada is demonstrated in the fact that the amount of nitrogen flushed into rivers by the seven largest cities in western Canada annually in the form of organic wastes "is equivalent to 75% of the nitrogen fertilizer purchased by farmers in the four western provinces."(Rowe, 1984, p. 56)

Return is also closely related to the second principle, integration in agricultural systems. The return of wastes to the land is an essential part of an integrated food production cycle. In the process of treating the land as part of a biological cycle and returning sewage and composted organic garbage to farmlands, pollution can be converted into prosperity.(Hicks, 1975, p. 120)

Return is included with production and consumption as one of the

three bases of living systems. (Berry, 1981, p. 85) Hicks further emphasized the importance of return in completing the cycle of agricultural systems, arguing that:

> The major ecological problem is, in my opinion, the food production cycle. The re-establishment and maintenance of this cycle, is, as I see it, a matter of survival. The closing of this cycle by sewage and organic garbage composting and return to the fields could convert pollution into prosperity, provided that the fields themselves were treated as part of the biological cycle. (1975, p. 120)

Advocates of the regenerative argue that if we are to build sustainability into our agricultural systems, we must be ready to return all non-toxic wastes to the land.

(4) Diversification

Diversification is a common characteristic of stable and productive systems. McGill explained that diversification helps reduce risk and optimizes the diversity inherent in the resource base. (1985, p. 193)

There are at least three contexts in which agricultural diversification can be encouraged. First, there is the diversity of species built into crop rotation systems as well as into polyculture systems which mimic the stability of natural ecosystems. (Rowe, 1984, p. 56) Second, the systems would be in conformance with the diverse kinds of land formations and soil types in each particular bioregion. Third, a a diversification of methods and economies would be employed.

(5) Small Scale Farm Systems

An ecologically sustainable farm would probably be smaller and feature more mixed croppings than the average conventional farm. This emphasis on smaller scale agriculture is not simply a naive glorification of that which is small. E.F. Schumacher, author of Small is Beautiful, was the first to argue that "small" is not always

"beautiful." But in our culture, which idolizes bigness, smallness is of value in many areas. Small-scale farming can be defended on the grounds that it has the potential for better protecting the land and natural resources, it provides more jobs, and it strengthens rural communities.

a. Protection of the land and natural resources--The first of five principles which Rowe listed as key characteristics of a more ecological agriculture is that of "small farms, many farms." He argued that, "The farmer working a small farm knows the land and appreciates its diversity."(Rowe, 1984, p. 56) Berry explained this aspect of the smallness principle, saying that:

> The practicality of the small farm may lie in the inherent human tendency to cherish what one has little of. I believe that land wasters always own or 'control' more land than they can or will pay attention to. (1981, p. xii)

Moreover, there is the danger that with the decline of small-scale, efficient farmers, future societies will have "lost the knowledge and wisdom required to operate a low- energy style of life."(Moles and Riker, 1984, p. 250)

b. Protection of the small farmer--Small farms portend higher employment and a reduced dependence on energy- and capital-intensive technologies. By allowing more people to become involved in agriculture, society could better optimize the use of the renewable resources available locally. The idea of labor intensity or livelihood intensity is common to Schumacher's "appropriate technology" as well as Chambers' "eco-technology."(Chamber, 1977, p. 27) In an age of chronic unemployment, human resources could be more effectively utilized by encouraging small-scale agriculture. This is especially true in developing countries which are labor-rich and capital-poor. As fossil fuels become depleted, labor-intensity is likely to be increasingly

applicable to overdeveloped countries as well.

c. Protection of rural culture--It has been argued that a farm population is essential to the health of small rural communities. The farm population provides an economic, social, and cultural base for these communities. Small-scale producers tend to be more adaptable than large-scale producers as they are able to fit into small markets as well as large markets.

There is also an ecological aspect to the impact of small-scale agriculture on cultural preservation. Responding to the question of why some cultures with very limited resources have prospered while other cultures with a wealth of ecological capital have self-destructed, Jackson suggested:

> ...it might be that many peoples who had few land and water resources to begin with set the cultural pattern for those who followed. People of the Netherlands who claimed swamps and mud flats from the sea, and Indians of the high Andes have preserved their precious natural heritage, indeed improved on the local environment. (1984a, p. 160)

Ecological and social problems in North American agriculture suggest that it might be necessary to establish new cultural patterns through which agricultural sustainability would become second nature. A population of small farms which follow the ecological principles outlined here might provide a firm foundation for such alternative, more sustainable, cultural patterns.

(6) Ecological Education

Improved public education in ecological issues is the last, but not the least, regenerative ecological principle. All sectors of modern industrial society need to become more aware "that their livelihood depends on, and that their actions influence, soil quality." (McGill, 1985, p. 193) Equipped with this ecological awareness, agricultural institutions could begin to emphasize that, "questions

about whether and to what extent our agricultural system is unsustainable become vital building blocks in the development of research priorities."(G. Brown, 1984, p. 150)

Agricultural research priorities have been so geared toward increased production through chemical-intensive methods that many basic ecological relationships underlying food production have been ignored. An incident which took place during a recent congressional subcommittee hearing on agriculture demonstrated the shortcomings of our research and education institutions with regard to fundamental ecological relationships in agriculture:

> A representative of the Office of Technological Assessment was discussing the findings of a major study on the effects of agricultural production on our resources and the environment. He said that many of the basic scientific issues about soil microbiology, soil formation, and crop production are difficult to resolve because the 'basic questions are not answered and in fact remain unasked.' My colleagues and I on the subcommittee found this answer profoundly disturbing. (G. Brown in Douglass, 1984, p. 150)

Answers to basic questions of agroecology should be researched through the testing and demonstration of integrated systems in a wide range of soil and climatic conditions. This research would treat soil as the basic element of a biological cycle and examine the inter-relationships between soils, plants, and soil-plant treatments. Ecological education would draw attention to technologies from a less energy- and capital-intensive agricultural past as well as new technological innovations.

B. Social Principles and Practices

Development planners and theorists have been using a variety of labels including 'bioregionalism', 'bottom-up planning', 'ecodevelopment', and 'sustainable development'(Wismer and Pell, 1985, pp. 29-30) in an attempt to define an emerging approach to development which is being called the regenerative paradigm in this thesis. All of

these approaches to development are based variations of the following sets of social principles and practices, which can be used as methodological guidelines for what Boyden called "an integrative ecological approach to the analysis of human settlements," both for existing communities and in plans for future settlements. (Boyden, 1979, p. 6)

Principles guiding regenerative agricultural development are designed to maximize the human resource potential and minimize demands on agricultural ecosystems. Referring to the human resource potential, Heilbroner has argued that societies need to redefine "development" in ways that "minimize the need for the accumulation of capital, stressing instead the education and vitality of their citizens." (1974, p. 134) Principles which contribute to the maximization of individual potential include justice, stewardship, a long-term economic perspective, participation, and voluntary simplicity.

Regenerative practices are designed to promote long- term sustainability through appropriate technology and organization. Schumacher's concept of "appropriate technology" provides a framework for economic and technological restraint and sensibility. By definition, "appropriate" or "intermediate" technologies are more productive and efficient than earlier primitive technologies and yet not as destructive and exploitative as the current agribusiness technologies. More "appropriate" technologies and organizational patterns for agriculture would seek to reduce or eliminate the problems of social dislocation, rapid consumption of nonrenewable resources, and degradation of the environment by more effectively utilizing the manpower, resources, environmental, and institutional realities in a given country. (Jedlicka, 1977)

For many, the current technologies of industrial agriculture have become masters, rather than alternatives among many tools in agricultural development. As Lovelock observed, "It used to be said of fire, the first of the technological weapons, that it was a good servant but a bad master. The same holds true of the newer weapons of technology."(1979,p.115) Agriculture has too diverse a potential to be locked into one particular approach, especially one that is self-destructive in so many ways.

There is much to learn about of the diverse potential of agriculture "from our own past, from the history and present practice of other peoples, from new technology, from new understandings of biology and ecology."(Berry,1977,p.180) Rather than seeking a nostalgic "return to the past," we must question the agricultural development patterns of the past. Modern scientific methods are needed to help develop new ecological and social technologies which would provide more stable, healthy, and sustainable agricultural systems.

Appropriate technologies should be designed to accomplish defined environmental and cultural goals, not as ends in themselves. They should be understandable and controllable by those they are meant to serve and should, in general, enhance rather than replace human capacity.(Wismer and Pell,1985,pp.29-30) They will tend to be "smaller, capital-saving, less rapacious in their demands on raw materials, environmentally non-violent, and leading toward an environmentally sustainable life-style."(Freudenberger, 1984,p.105)

Among the social principles and practices being recommended by advocates of the regenerative paradigm are regenerative zone development, integrated rural development, alternative human waste disposal, biosphere reserves, farmer-oriented development, and social

ecology.

(1) Regenerative Zone Development

Gabel and Rodale described the concept of a Regenerative Zone Development Plan. It refers to a regional locus of control and is defined as "a method of recognizing, defining, and solving society's problems...through the development of regenerative technologies on a regional scale."(Gabel and Rodale, 1985, p. 2) They explained that:

> Regenerative technology or programs are not energy- or material-intensive, but rather, information- intensive... Regenerative technology works with nature, not against it. It starts with honoring the value of natural systems and takes advantage of the natural energy and materials and harnesses these flows and cycles to bring about desired conditions. (p. 422)

Similarly, Wismer and Pell referred to local self- reliance as a development strategy. It which be designed to assure, to the greatest degree possible, the maximization of the use of locally renewable resources to serve the basic needs of local people for food, shelter, livelihood, and security. (1985, pp. 29-30)

In the rural sociology literature, the extent of bioregionalism can be described using the term articulation. According to Buttel, "Articulation refers to the extent to which the production activities of a region have backward and forward linkages with producers and consumers in that same region." (Buttel, 1983, p. 112) Greater articulation through a regenerative bioregional approach to development tends to encourage greater social and ecological balance.

(2) Integrated Rural Development

This is a popular concept among international development specialists seeking a more holistic approach to development. It is defined as an integrated study "designed to gain a better understanding of the structure and functioning of human settlements of various sizes viewed from an ecological perspective."(Boyden, 1979, p. 6) For the 60%

of the world's population which live in villages, "development could not be anything other than rural."(Crener,et al.,1984,p.7)

Integrated rural development has been employed primarily on the international development scene and has seldom been used in the North American context. In North America, "development" is all too often considered synonymous with "economic growth." An over-emphasis on economic growth in agricultural development is currently contributing to resource depletion, pollution, and other problems. In reality, "economic growth" is just one factor within a larger process which we call "development." Social, political, and educational, and many other factors must be taken into consideration in development. Whereas "economic growth" tends to be a quantitative measure of increasing economic activity, "development" connotes a qualitative process through which a set of means lead to a corresponding set of desired ends.

Buttel defined **rural development** as, "The ongoing and potential public policies through which social and economic conditions of rural people can be improved."(Buttel,1983,p.105) The point of an integrated approach is to consider as many local environmental conditions as possible, both social and ecological, in planning development strategies.(Crener,et al.,1984,p.vi) In the process, development becomes a gradual process of improving local conditions.

Strategies available within the integrated perspective include cooperative development and land reform. Cooperative development is defended as an alternative to the overly-competitive atmosphere of modern industrial society (Douglass,1984,p.18; Slater,1970,p.150) and as the "touchstone of human progress."(Heilbroner,1974,p.123) Land reform is described by Jacoby in this way:

> Land reform or agrarian reform are the terms most frequently used to denote any integrated programme that aims at reorganizing the

> institutional framework of agriculture in order to facilitate social and economic progress in accordance with the philosophy, values and creed of the community concerned. (Jacoby, 1971, p. 24)

(3) Alternative Human Waste Disposal Systems

The return of organic wastes to the soil is a critical element of an integrated, sustainable agricultural system. There is considerable room for improvement in the rate of return of human wastes to agricultural lands. Two systems have been designed to help integrate human wastes into the cycle of soil productivity -- the Solar Aquaculture Wastewater Treatment Plant (SAWTP) and the Clivus Multrum.

The SAWTP is a municipal waste treatment system in Hercules, California which uses a polyculture of hyacinths and duckweed (with fibrous roots to trap solid wastes), snails, frogs and fish in the final stage of treatment to remove toxic chemicals from the sludge. (Smith, 1981, p. 10) According to the system's designers, these agents can metabolize and remove wastewater nutrients, herbicides, pesticides, phenols and heavy metals, thus preparing municipal sludge for safe application to farmlands. Other sewage treatment plants rely on monoculture systems, which are incapable of altering these toxic chemicals.

Hyacinths and duckweed thrive in this environment and are harvested frequently. In the future, the harvested plants could be used for organic compost, supplemental cattlefeed, and as fuel to power the facility. The Environmental Protection Agency expects the plant to operate up to 94 percent more cost-effectively than conventional facilities when it is expanded to treat two million gallons of watewater a day. (Smith, 1981, p. 10)

A more decentralized treatment system which returns human wastes to the soil as humus is the Clivus Multrum, a combined toilet and

garbage disposal that uses no water. Developed by the Swedish engineer Rikard Lindstrom, the Clivus Multrum could be installed in every home in most American cities for the amount of money needed to modernize the overloaded and inadequate sewage systems of many of those cities. (Stavrianos, 1976, p. 32)

(4) Biosphere Reserves

One of the components of the United Nations' "Man and Biosphere" (MAB) project is a network of "**biosphere reserves.**" Biosphere reserves are relevant to the regenerative paradigm because they have the potential for integrating research in some or all of the above-mentioned ecological practices into regenerative development strategies for areas needing ecological rehabilitation.

Rather than describing a specific biosphere reserve, it would be more useful to define the ideal biosphere reserve and then to briefly describe each of the key elements of such a reserve. The ideal biosphere reserve:

> ...conserves all of the representative ecosystems of a particular natural region. It contains the greatest possible diversity of physical physical and biological resources. It carries out a wide range of research, education, training, and demonstration activities in contiguous or nearby areas. Together, these activities provide the knowledge and skills needed to conserve biological diversity while enabling the ecosystems to be managed on a sustainable basis. (Gregg and McGean, 1985, p. 45)

The following components make up an ideal biosphere reserve:

(i) Core Zone -- This area is set aside for the conservation of natural ecosystems and biological diversity. It provides the models of equilibrium in local environments that can be used as baselines for ecological monitoring.

(ii) Traditional Use Area -- An ideal biosphere reserve would conserve and study the harmonious land use patterns that evolved within indigenous cultures. (Gregg and McGean, 1985, p. 45) This act of

conservation would not just be out of nostalgia, but would protect sustainable systems which developed over centuries. The restoration of small farms worked organically with animals, careful rotation of crops and returning manures to the land would serve ecological as well as social purposes.

(iii) Rehabilitation Area -- Dubos has called the recycling of degraded environments "one of the most urgent tasks of our age." (Dubos, 1975, p. 108) An area for ecological reclamation would demonstrate methods for restoring degraded landscapes.

(iv) Experimental Research Area -- Experimental farms for research on managed ecosystems have been recommended for many years. In the 1930s, Baker and Borsodi called for experimental farms which would help build up soil while reducing dependency on resources from off the farm. (Baker & Borsodi, 1939, p. 200) Nearly 50 years later, a Canadian ecologist, Stuart Hill, makes a strong case for similar experimental sustainable farm systems. (Hill, 1985, p. 34) Douglass also states the need clearly when he argued that, "Effective scientific and technological institutions devoted to the task of establishing ecologically sustainable arrangements unique to local ecosystems must be set in place and maintained." (Douglass, 1984, p. 273)

(iv) Multiple Use Area (Area of Cooperation) -- Finally, a mixed demonstration area would illustrate how the short- term demands for the development of human settlements could be balanced with conservation practices for the long-term protection of the health of the natural resource base. In balancing the demands of development and conservation within the biosphere reserve, prototypical patterns for sustainable agriculture and sustainable communities could be established.

(5) Farmer-Oriented Development

A theme which has been studied by a growing number of rural sociologists in connection with improvement of farm and nonfarm rural conditions is that of "people coming first"--especially the farmer. (Ashby, 1985, pp. 377-378) This theme is highlighted in a compilation book entitled Higher- Yielding Human Systems for Agriculture, edited by Foote and Boynton, as well as in Cernea's keynote address to the VIth World Congress for Rural Sociology, entitled "Putting People First: The Position of Sociological Knowledge in Planned Rural Development." Cernea and others argue that by including rural sociologists in inter-disciplinary research teams, more successful and people-oriented development patterns can arise. Traitler stated the case well when he argued that, "If we have put our faith in capital, technology and know-how as the prime agents of development, maybe we now have to put our faith in social justice, self- reliance and the people's aspirations first."(Traitler, p. 4)

(6) The Social Ecology of Agriculture

Social ecology offers social scientists an opportunity to reintegrate our understanding of agricultural development. Social ecology is one step in a larger transition away from the highly specialized industrial world view toward a more holistic, ecological world view. Coughenour defended this approach to agricultural development, explaining that:

> The issue, therefore, is how the bundle of socioeconomic costs and benefits of instrumental activity is composed and may be modified to provide positive net benefits for adaptive strategies that are more ecologically benign. (1984, p. 16)

In the social ecology approach, there is an appreciation of the existence of a social-political-economic structure and the importance of understanding social process if one is concerned with creating

circumstances in which agricultural sustainability can become a reality. (Moles and Riker, 1984, p. 261) It is an inter-disciplinary approach to agricultural development which is being approached by such diverse disciplines as human ecology (the study of people in relation to the total living system around them), economic and ecological anthropology and organizational sociology (concerned with the relationships between social organizations and their environments), resource economics (which is broadening its scope to include sociological issues), and economic sociology (which can be extended to incorporate environmental factors). (Coughenour, 1984, p. 2)

Already, a number of valuable crossover concepts have been recognized through social ecology analysis, such as niche theory, which has long been an ecological term in biology but also applies to niches within the farm economy. For example, social ecology methodology is used to describe the phenomena by which farmers are forced into niches which promote short-term economic survival but threaten long-term ecological sustainability.

Social ecology is a fitting concept with which to conclude this discussion of regenerative principles and practices. It reflects the interwoven and often parallel patterns of ecological and social health. These are just a few of the key concepts being advocated within the regenerative paradigm.

CHAPTER VIII

A CONCEPTUAL MODEL OF ALTERNATIVE AGRICULTURE FUTURES

A conceptual model is presented in this chapter to help illustrate the types of relationships which reinforce trends toward either systemic breakdown or systemic health. Using an integrated living systems approach, it is argued that a process of circular and cumulative causation leads either to descendence or to transcendence. Values are depicted as a primary force directing the course of agricultural development.

A. An Integrated Living Systems Approach

A number of scientists have enhanced our understanding of the type of relationships which reinforce trends toward either systemic breakdown or systemic health in agriculture through integrated living systems approaches. Howard (1947) treated the health of soils, plants, animals, and man as one great subject. Haskell (1972) outlined a model of unified science and Miller (1978) presented a unified theory of living systems. In a more recent study of agricultural sustainability, Douglass brought together issues of land stewardship with those promoting the health of communities in a broader social and ecological sense. (1984, p. 21) Through these widening perspectives on integrated living systems, perhaps there can "be revealed the harmony that unites many different positions, so that the 'sterile and ignorant polemics' can be abated." (Becker, 1973, p. x)

Since all living systems share a common evolutionary origin (Miller, 1978, p. 1044), it is reasonable to assume that cross-level connections exist both in patterns of systemic decline and systemic health. As Western science rediscovers the principle of interconnectedness which underlies all life, it is likely that we may

begin to better understand life's evolutionary "growth, its dynamic unfolding; its dialectics, its transformations." (Skolimowski, 1981, p. 70)

B. Circular and Cumulative Causation

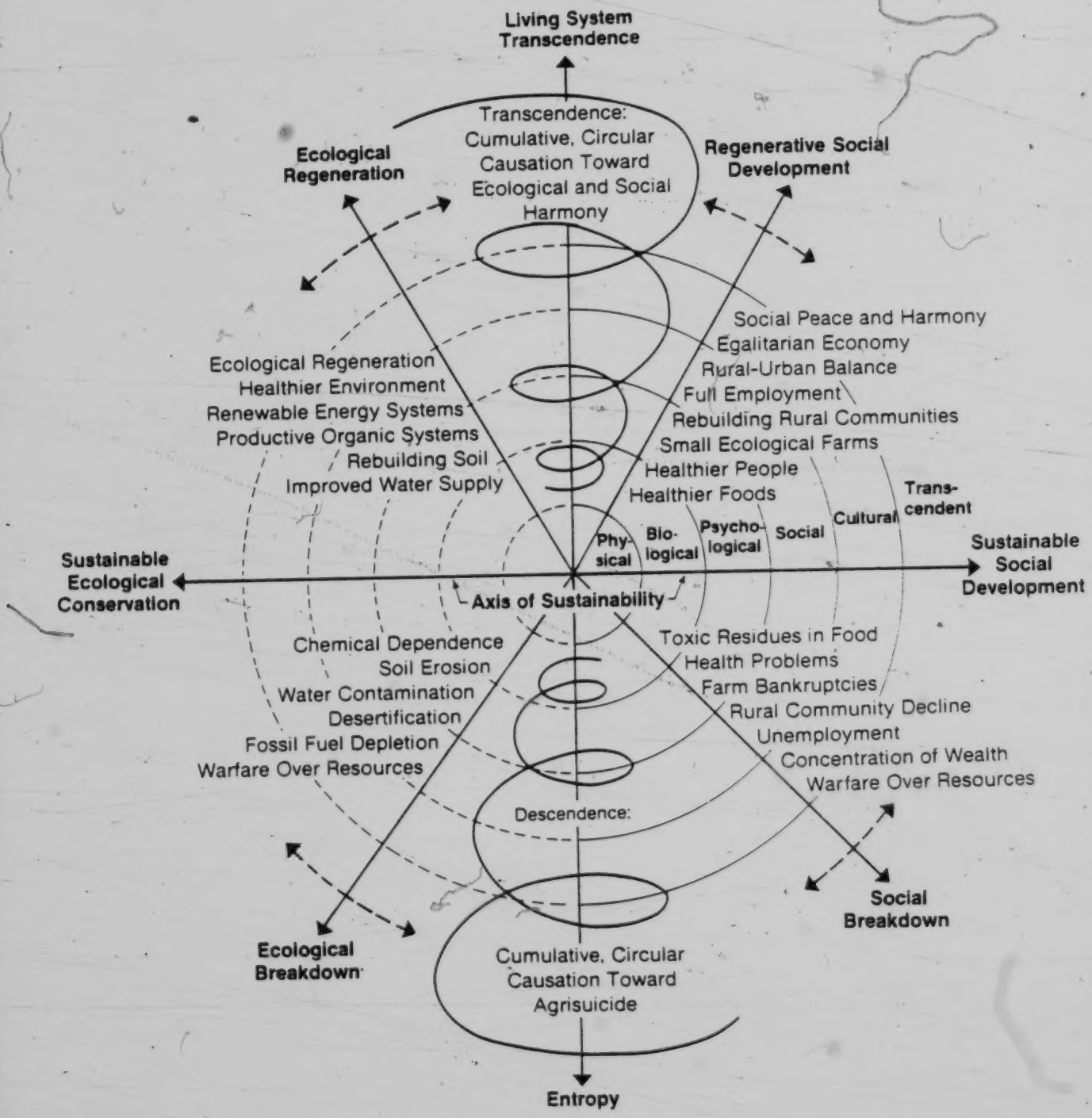
The principle of "circular and cumulative causation" is introduced in Figure 2 below. The concept was developed by Myrdal to explain the cycle of poverty in which he saw black Americans mired through the 1950s. He suggested that "it is useless to look for one predominant factor, a 'basic factor' such as the 'economic factor,'" causing decline in social systems and added that "everything is cause to everything else in an inter-locking circular manner." (Myrdal, 1957, p. 383) Applying this principle to Third World poverty, he argued there is "a circular constellation of forces tending to act and react upon one another in such a way as to keep a poor country in a state of poverty." (1957, p. 375)

Much of the evidence presented in this study suggests that Myrdal's hypothesis may apply to the relationships in agricultural development, though causal links have not been proven. Moreover, the principle of circular and cumulative causation seems to be working in both directions. When agricultural development is moving toward higher levels of entropy, there appears to be escalating levels of ecological and social breakdown. Conversely, when entropy is reduced through actions contributing to the health of the land, the people, and the communities based in agriculture, greater harmony seems to emerge at physical, biological, psychological, social, and cultural levels. L. Brown described this phenomenon:

> Contemporary problems seem seamless, interconnected, and difficult to address in isolation. But this seamlessness has another side. If progress is made on some fronts, it is likely to translate into progress on many others. (1981, p. 370)

Figure 2.

Larrick's Model of Alternative Agricultural Futures



By analyzing a variety of ecological and social indicators over a time series using the model in Figure 2, these trends within agriculture can be analyzed in a more holistic way. Such an analysis would go beyond the approaches which dominate current agricultural analyses. By viewing agriculture primarily as a multi-level living system rather than as an industrial system, we may better understand the processes promoting the long-term ecological and social sustainability of agriculture.

C. Descendence: Increasing Entropy In Agriculture

(1) Escalating Ecological Breakdown

The process of cumulative, escalating ecological breakdown, or descendence", was demonstrated in Chapter IV through the impact of three major components of industrialized agriculture: monoculture systems, a growing dependence on chemical additives for productivity, and a growing dependence on increasingly large farm machinery.

The faster we bring on these industrial technologies, it appears, the faster available energy is dissipated and the more disorder mounts. While fossil fuels are being depleted and increasing levels of pollution are being generated, ecological income of solar and biological energy are being wasted.

(2) Escalating Breakdown of the Social Ecology

Just as the industrialization of agriculture is creating ecological problems, similarly, it is cutting into the social fabric of society. As explained in Chapter IV, it is doing so by displacing the farm population, which leads to the closing of rural schools, churches, and other institutions, and the impoverishment of rural communities. In turn, it is contributing to the breakdown of family patterns and fostering a wide range of social pathologies such as unemployment,

suicide, alienation, abuse, and increased crime. In addition, Douglass explained the negative social ramifications of the growing concentration of wealth and power resulting from industrial agriculture systems:

> Actions which enrich or enoble one member at the expense of another are self-defeating; failure to come to the aid of a member in distress, or to oppose exploitative behavior within the community, undermines the vitality and health of the whole community. (Douglass, 1984, p. 18)

A growing GNP, a sign of prosperity in the industrial way of thinking, has often coincided with a declining agriculture. Factors inflating the GNP include an increased dependence on insecticides, herbicides, synthetic fertilizers; larger, more expensive farm machinery; a variety of other previously unnecessary inputs for farmers; pollution cleanup efforts such as water treatment plants for the removal of agricultural chemicals; unemployment payments for former farmers; the building of new housing on farmland outside of sprawling urban areas; growing police forces to control increasing urban crime; and the cost of treating a wide range of urban and rural social pathologies. In turn, over-production of agricultural commodities has led to the need for expensive price support systems.

(3) Agrisuicide

Alfred North Whitehead once said, "Any physical object which by its influence deteriorates its environment commits suicide."(Science and the Modern World, 1925) A recurring theme throughout a wide range of literature on modern industrial agriculture is the system's tendency toward self- destruction. It appears that a new term is needed to reflect the trends taking place in industrialized agriculture and that term is agrisuicide. Agrisuicide would describe a system of food production which is both environmentally and socially self-destructive

to the point that it is not sustainable.

The application of industrial economics to agriculture has been destructive because it fails to adequately recognize and promote the health of agriculture as a complex multi-level living system. As Berry explained, "In a biological pattern--as in the pattern of a community--the exploitative means and motives of industrial economics are immediately destructive and ultimately suicidal." (1981, p. 144)

All too often, profit-maximization has been based on private short-term gain at public long-term expense. This is contributing to high levels of soil degradation, agricultural pollution, and social dislocation. Just when people throughout the world are being forced off the land by the introduction of energy- and capital-intensive technologies, the exhaustible resources upon which this dislocation depends are declining.

It appears that the problems of industrial agriculture are part of a bigger problem of modern industrial society. Berry complained that, "Orthodox agriculture is part of the larger orthodoxy of industrial progress and economic growth, which argues the necessity of pollution, unemployment, war, land spoliation." (1977, p. 173) Rowe argued that industrial agriculture defies a spirit of care for the land and for community, and is "increasingly mechanized and industrialized, a city-guided pursuit with goals that inevitably are at odds with survival." (Rowe, 1984, p. 54) Similarly, Hicks warned of the danger of applying "mechanical" economic models rather than "biological" or "ecological" economic models to agriculture, saying that:

> ...the present attempts to mechanise and force food production, in accordance with economic instead biological principles, by relying exclusively on artificial fertilisers, pesticides and weedicides, must ultimately result in the destruction of the basis of human life. (Hicks, 1975, p. 76)

While we may feel comfortable with the industrial society we have grown up in, it cannot be assumed that it is the way of the future. A recent report of the National Academy of Science warned that in our "greatest energy- spending spree of all times," our agricultural system is "exhausting fossil fuels, ruining soil fertility, unbalancing ecosystems, and distorting human values and institutions."(NAS, 1980)

North American agriculture appears to be on a collision course, warned Congressman G. Brown. He said, "this country is cruising rapidly and haphazardly toward a major economic, political, and ethical dilemma involving food, the ability to produce it, and who will be given access to it."(In Douglass, 1984, p. 156) Berry described the futility of failing to meet the requirements of the health of the land:

> An agriculture cannot survive long at the expense of the natural systems that support it and provide it with models. A culture cannot survive long at the expense of its agricultural or of its natural sources. To live at the expense of the source of life is obviously suicidal. (1977, p. 47)

Looking to the long-term future of agriculture, it makes little ecological or social sense to build a growing global population upon "an agricultural system on which the basic principle is its willingness to destroy itself."(Berry, 1981, p. 67) The sustainable path of conservation is dictated to us by the law of entropy. Modern industrial society's unwillingness to deal appropriately with the problem of entropy has been compared to a man jumping off a building to prove the nonexistence of gravity. (Rifkin, 1980, p. 238) Rifkin warned that:

> ...ecologists and economists like Georgescu-Roegen, Daly, Odum, Bookchin, and Ophuls would argue that to ignore the historical reality in front of us in favor of maintaining false expectations is sheer madness and will lead to an even greater fall for humankind, perhaps an irreversible one. (1980, p. 203)

History has shown that a caring attitude toward the land and the life on it is critical for long-term societal survival. The process of

agricultural decline in the absence of a sense of ecological responsibility is described by L. Brown who said, "Without an environmental ethic that preserves the biological and agronomic underpinnings of society, civilization will collapse." (1981, p. 352) Recognizing the importance of such a land ethic, Lowdermilk drafted an "Eleventh Commandment" in 1939 which he argued that Moses would have added to the stone tablets "if he had been able to foresee what suicidal agriculture would do to the land of the holy earth." (Freudenberger, 1984, p. 26)

Agrisuicide has been committed by past civilizations and it can happen again. Day argued that a major international effort needs to be undertaken by researchers and policy-makers to avert greater agricultural disasters in the future. He insisted that:

> The possibility of such destruction must be taken seriously by any student of history and prehistory. The artifacts of wondrous past civilizations warn us of this truth. Thus, while a call for greater resources for the intellectual community is self-serving, it is also a call to social service... in the dialectic process by which the human mind seeks to understand and to enhance its own evolution. (Day, 1982, p. 263)

The pressures and the stakes in agriculture today are greater than ever before. Although the current degradation of cropland is not new, the demands of an unparalleled and rising global population for higher agricultural production is creating ecological pressures, and socio-economically, "unequal access to land and jobs bespeak a mounting crisis of calamitous proportions." (Douglass, 1984, p. xi) Agriculture's future is in need of creative transformation, for as Day explained:

> A growing crisis is seen in the current trends in population, energy utilization, and food production--a crisis whose magnitude, duration, and inception cannot be predicted but whose inevitability and significance can now, on the basis of recent experience, be safely assumed. Averting of extreme dislocation will require energetic technical and socioeconomic innovation. (Day, 1982, p. 256)

D. Transcendence: Regeneration Through Entopic Analysis

If, as many scholars have warned, "Our choice today may well be utopia or oblivion,"(Coates,1981,p.42; see also Henderson, 1981,p.xx and Lekachman,1976,p.270)), then the utopian option should be assessed. Utopian thinking has been a driving force for social change throughout history. As Lewis Mumford has observed, utopias provide us with ideals toward which people can aspire.(Wagenknecht,1929,p.16) It is from goals and dreams, when acted upon, that desirable change comes about. Anatole France argued that, "Without the Utopians of other times, men would still live in caves, miserable and naked. It was Utopians who traced the lines of the first city." (Wagenknecht,1929,p.15)

Boyden described the crisis facing modern industrial agriculture as "the greatest challenge mankind has ever faced; the human capacity for cultural adaptation is now being put to the test as never before."(1979,p.16) The urgent need for a positive perspective is reflected in the fact that while technological change has continually outrun social organization, "High yielding social organizations are not less important for development than high yielding crop varieties and intensified agriculture cannot occur without intensified human organization." (Cernea,1984,p.8) Recognizing the need for such social innovation, Day agrued that:

> ...society must have within itself at all times a dedicated cadre of socioeconomic inventors, innovators, and engineers. For it is from this cadre that must come the new organizations and mechanisms to overcome the crises leading to cultural and possibly demographic destruction.(Day,1982,p.263)

A growing cadre of agricultural analysts are beginning to recognize that our current agricultural system is seriously, even fatally flawed, and that a bold new approach to the structure and practice of agriculture is possible, and even likely. (Freudenberger,1984,p.105; Heilbroner,1974,p.133; Hill,1985,p.36;

Johnson, 1979, p. 235; Stavrianos, 1976, p. 37; and Zwerdling, 1983, p. 23) Moreover, key social and ecological factors are converging to make this period of history ripe for innovative solutions.

On the one hand, humanity is moving in many directions at once and, at the same time. On the other hand, there is a growing awareness that we are all part of the same living system on this planet. Stavrianos sees this contemporaneous blending of diversity and unity as an ideal situation for significant transformation. He explained that:

> ...we are living in a world that is experiencing unprecedented innovation and experimentation at the same time that it is shrinking into a global village. This juxtaposition of diversity and unity suggests that the law of hybrid vigor operates today in the realm of cultural evolution as well as that of biology, thereby facilitating a creative response to the scourges that have afflicted humanity throughout history. (Stavrianos, 1974, p. viii)

Within this context, the regenerative agriculture movement has the potential for becoming much more than just a fine-tuning of a few agricultural practices to cut farmers' costs or simply to slow down the erosion of soil. Barnhart argued that, "development of life-supporting strategies which are sustainable and environmentally benign is the only way of reducing the probability of future famine, disease and war."(In Coates, 1981, p. 479) Similarly, Schumacher spoke for many in warning that the problems being created by modern industrial society:

> ...will become worse and end in disaster, until or unless we develop a new life-style which is compatible with the real needs of human nature, with the health of living nature around us, and with the resource endowment of the world. (1973, p. 144)

Hope is a key element in the transformation of society toward social and ecological sustainability. In The Revolution of Hope: Toward a Humanized Technology, Fromm explained that hope fosters vision which fosters positive transformation. On the other hand, "Those whose hope is weak settle down for comfort or for violence."(Ferre, 1976, p. 189) Those with self-centered life goals settle for comfort and

those of a cynical nature settle for the violence of a self-destructing industrial society. (Slater, 1970, p. 150) Ferre sought to counter this cynicism and comfort-seeking when he argued that:

> Our sense of helplessness before the seemingly autonomous system as it continues to accelerate its mad rationality toward ruin must not be allowed to sap our courage to define, and press for, new direction. (Ferre, 1976)

Unfortunately, just when a new vision of hope is needed, it has been slow coming. As Meisner complained, we live "in an age which suffers from a paucity of utopian imagination." (Meisner, 1982, p. xiii) Similarly, Joseph Blasi, Director of the Project for Kibbutz Studies at Harvard University asked the question, "Have we not lost the capacity to think about how the 'good life' is created?" (1980, p. iii)

(1) Entopic Analysis

Responding to a perceived need for entopian vision, the process of "entopic analysis" has been introduced as an analytical tool to help evaluate existing social and ecological principles and systems in terms of their potential for promoting long-term stability, creativity, health, and sustainability. (Doxiadis, 1977, p. 14) Through entopic analysis prototypes are sought for a social and ecological transformation toward a more just and sustainable world. Barnhart described his vision of a sustainable agricultural system this way:

> By merging modern scientific tools and information, we want to create more benign methods of providing food, shelter, and energy. We are evolving a theory of design that turns to nature for models of sustainable communities and translates them into design principles for meeting basic human needs. (In Coates, 1981, p. 481)

Entopic analysis is an attempt to re-integrate our knowledge of the physical and social environment in order to use knowledge in pursuit of more ideal communities. It is an integrated study of regenerative ecological and social principles and practices in order to direct systems toward more regenerative and creative eco-economic

equilibriums. Regenerative systems will hopefully be able to go beyond sustainability into the realm of repair, restoration, and growth.

Entopic analysis is based upon a foundation of practical experiences from the past, upon the characteristics and motivations of people and societies in the present, and upon reasonable projections of the likely outcomes of actions we take today. It involves "a systematic, exploratory, and careful scientific evaluation of communities, experiments, visions and practical proposals which really can restitch the nets of human fellowship."(Blasi, 1980, p. xii)

Entopic analysis is an attempt to mobilize a segment of the vast storehouse of ecological and social knowledge. It is hoped that by adopting the principles, practices, patterns, and technologies which best promote the health of the soil, of people, and of communities, we may set in motion a cumulative process of escalating multi-level regeneration. Along this entopian path may be the ways and means of long-term agricultural sustainability. In ideal systems, the goals of social development would be the same as the goals of ecological conservation, thus increasing the potential for higher levels of life's transcendence.

(2) Ecological Conservation Through Regeneration

An article in The Ecologist suggested that the current industrial agriculture system will either "end in massive destruction or it will end because we wish to create a society which will not impose hardship and cruelty upon our children--in a succession of thoughtful, humane and measured changes."(Coates, 1981, p. 3) Some of these necessary changes are already taking place in North America in the form of actions taken by people within the regenerative agriculture movement. But there is still a long way to go and the momentum still seem to be

moving in the direction of increasing industrialization.

Rather than continuing to degrade life to the mechanical, this study has attempted to elevate the organically derived resources of topsoil and fossil fuels to the continuum of life's evolution. These resources have been depicted as the ecological capital which has been accumulated by life over hundreds of millions of years. The continued abuse of these resources by short-sighted development patterns are likely to lead to catastrophe for life on earth. Used wisely, they can enhance life's evolutionary potential well into the future.

Since food production occurs within a complex, mutually influential living system of soil, plants, animals, and people, solutions to food production problems are likely to be ecologically, agriculturally, and culturally healthful. (Berry, 1981, p. 137) Healthy solutions can be expected to cause an amplifying series of solutions--healthier soils, plants, animals, farmers, and communities. By intelligently redesigning our agricultural systems in accordance with factors which encourage health, it is conceivable that many of our problems could be solved. L. Brown recognized this principle, pointing out that:

> If we abandon our exploitative relationship with nature, we may be less inclined to exploit each other. At the international level, we may begin to see that the real threat to the long-term security of nations and of civilization itself lies less in military conflict than in the unsustainability of society as it is currently organized. (1981, p. 371)

(3) Social Development Through Regeneration

Entopian analysis should contribute to the process of forging the new values, institutions, relationships, and social and ecological technologies with which to build a sustainable agriculture and society. There is a need to investigate many diverse alternatives. Barnet and Muller explained that, "The road to alternative practical solutions

leads by way of social experimentation."(Barnet and Muller, 1974, p. 387)

An emphasis on meeting basic human needs is a critical element in building a sustainable society. As Milbrath noted, "Justice for all, then, is a basic emotive glue that supports a value system for a sustainable society."(Milbrath, 1984, p. 119) In The Wealth of Some Nations, M. Caldwell used the concept of homeostasis as a sort of entopian concept which transcends underdevelopment and overdevelopment. He defined homeostasis as "a sustainable eco-equilibrium."(Caldwell, 1977, p. 139)

Similarly, in Toward a New Approach to Development, Dasgupta recommended a "no poverty--no development economy" which would eliminate poverty but would not engage societies in the lust for economic development which is perceived as the root of exploitation and violence. He argued that feelings of greed must give way to feelings of contentment and aspirations for more to feelings of satisfaction. He suggested that, "It is not beyond the human ingenuity to devise the package; provided we are prepared to think." (Dasgupta, 1980, p. 15)

Much more than thinking is needed to redirect society toward greater sustainability. As Milbrath explained, the encouragement of a universal compassion or empathy is needed:

> This generalized love for others that characterizes humans in a civil society extends to other species, to all of nature. For many people, this love for other species and nature can only be sustained within a viable ecosystem that supports many thousands of other forms of life. (Milbrath, 1984, p. 119)

North America society has the resources to develop a sustainable agriculture system today, but must first develop the value system and the will necessary to accomplish the task. Johnson argued that we are in a favorable position to make this entopian step into the future, noting that:

> We are entering the future with a great deal in our favor. We have

> peace, a vast storehouse of knowledge, plenty of the necessary resources of land, water, air, and sunshine, the tools we need, the scientific knowledge of how to use them effectively, and a rich cultural heritage to draw on. (Johnson, 1978, pp. 236-237)

E. Value Choices: Choosing the Future

Heisenberg called values "the compass by which we must steer our ship if we are to set a true course through life." (In Haskell, 1972, p. 43) Values set the societal priorities which shape patterns of both ecological conservation and social development. As depicted in Figure 2, values, in effect, point the compass toward increasing entropy or toward reduced entropy through the regenerative potential of living systems.

The entopian perspective assumes that existing structures and institutions are mere human constructs which can be transformed through human action. The utopian socialist Robert Owen reflected this perspective when he observed that, "Man is the creature of circumstances." Similarly, Dubos has observed that, "Man shapes himself through decisions that shape his environment." (Peter, 1977, p. 172)

According to this perspective, the world is not inevitably good or bad, but only as good or bad as we make it. (Heilbroner, 1974, p. 113) If we are to build a sustainable agricultural system, our choices must be guided by "a vision of a desirable human society and the quality of relation to the earth." (Freudenberger, 1984, p. 133) Such a vision must begin with a thorough understanding of the relationship between physical, biological, and human resources.

Just as healthy patterns within the agricultural development process are likely to lead to healthy relationships, so too are unhealthy patterns likely to contribute to the likelihood of unhealthy relationships. (Boyden, 1979, p. 68) To prevent unhealthy relationships

from developing, Miller explained that unhealthy patterns must be identified and ameliorated. He asserted that:

> If a relationship can be found among deviations from normal steady-state ranges in various parts of a system, this relationship can be identified as a syndrome, and its underlying cause or causes can be sought. Efforts can be made to remedy pathological structures or processes. (1978, p. 1046)

In keeping with Miller's assessment, pathological structures and processes of industrialized agriculture have been identified in this study. Societal values will decide whether agriculture will be a noncyclic industrial process or a cyclic process capable of regenerating and reproducing itself indefinitely.

CHAPTER IX

SUMMARY AND CONCLUSION

This study has treated the long-term health and survival of agricultural systems as a central research problem. Both the industrial and regenerative paradigms have been evaluated in terms of the likelihood of promoting long-term social and ecological sustainability. In defense of approaching a problem of these dimensions, Burch and Wade have argued that, "Understanding the means of survival used by social species is still very much the central resource question of rural sociology--as it should be for all social sciences."(1985,p.94)

Analyzing a problem of this scope has required the integration of a broad range of scientific disciplines. This is in keeping with Baric's assessment that, "In solving our problems of universal human preservation, we need every disciplinary weapon we have."(1981,p.4)

The four primary objectives of the study, as outlined in Chapter I, were: (1) to describe ecological and social problems resulting from the way agriculture is practiced in North America; (2) to describe and analyze value- orientations of key sectors of modern industrial society which tend to encourage agricultural practices with high long-term social and ecological costs; (3) to describe the values, principles, and practices common in the regenerative agriculture movement; and (4) to develop a conceptual model reflecting the reflecting the primary relationships and forces at work in agricultural development as a tool to help evaluate the long-term sustainability of alternative agricultural futures.

A. Summarizing the Contrasting Paradigms

(1) The Industrial Paradigm

Examination of the techniques (Chapter IV) and values (Chapter V) of the industrial paradigm revealed a number of trends which threaten the long-term sustainability of agriculture in North America. Evidence was presented of a wide range of ecological and social problems being generated or exacerbated by industrial patterns of agricultural development. Two common characteristics among many of these problems were that entropy was being speeded up and living systems at various levels of agriculture were being diminished by industrial practices. These problems were seen as contributing to a circular, cumulative process of multi-level long-term decline in agriculture.

Commonly-held values identified as being at the root of the agricultural crises were: (1) a mechanistic worldview; (2) the domination of short-term private interests; and (3) an urban bias. Many writers cited in this study have pointed to the series of negative ecological and social effects resulting from these orientations and have argued that the attempt to subjugate the biosphere to the demands of an urban industrial society is doomed to failure. Freudenberger explained that, "We are beginning to see that agriculture, as it is practiced today, as well as in the past, is the problem. A whole new approach, new technology, and infrastructure are required."(1984, p.73)

The current orientation of urban industrial society with respect to agriculture is part of a larger societal paradigm which is being challenged on a growing number of fronts by an emerging regenerative paradigm, as depicted in Table 4 below:

Table V. Alternative Agricultural Paradigms

	INDUSTRIAL PARADIGM FOR AGRICULTURE	REGENERATIVE PARADIGM FOR AGRICULTURE
Basis of Actions	The Teaching of Profits	The Teaching of Prophets
Definition of Efficiency	Production per Man-Hour (Job eliminating)	Production per calorie Input (Job Intensive)
Development Strategy	Trickle Down	Development From Below
Driving Force in Development	Greed	Need
Economic Model For Future	Unlimited Material Progress	Steady-State Economics
Energy Resource Base	Dependence on Nonrenewable Fossil Fuels	Development of Renewable Resources
Institutional Scale	Large, Centralized Institutions	Small, Decentralized Institutions
Mythical Hero	Paul Bunyan	Johnny Appleseed
Population Distribution	Centralized/Urbanized	Decentralized, Rural-Urban Balance
Relation to Entropy	Industrialization Speeds Up Entropy	Living Systems Slow Down Entropy
Relation to Nature	Domination/Exploitation of Nature	Cooperation, Harmony With Nature
Response to Mortality	Denial of Creatureliness	Enlightened Animalism
Role of Living Systems	Reduce Living Systems to Mechanical	Elevate Living Systems to CounterEntropy
Stage of Social Development	Colonizing Stage	Climactic Stage
Technological Development	Technologies Adopted--Society & Environment Must Adapt	Social and Environmental Impact Analysis Through Development
World View	Mechanistic and Reductionist	Ecological and Holistic

(2) The Regenerative Paradigm

Value orientations (Chapter VI) and practices and principles (Chapter VII) common within the a growing social movement for more regenerative agricultural systems in North America were described in this study. These regenerative values and patterns of agricultural development have been offered as guidelines for developing more ecologically and socially sustainable alternatives for agriculture.

A prerequisite to a more stable, sustainable agriculture is a reorientation of mechanistic relationships with nature from a position of power and domination to one of mutual trust and cooperation. (Fukuoka, 1978, p. 15) Linear thinking may have worked in an earlier industrial age, but it is now a major obstacle to understanding the complex, nonlinear, interwoven workings of global society. (Henderson, 1981, p. 61; Ferre, 1976, p. 79) Needed is the ecological recognition that "our planet includes man as a part of, or partner in, a very democratic entity." (Lovelock, 1979, p. 145; See also Hicks, 1975, p. 120 and Rifkin, 1980, p. 202)

In the past, planners have established minimum "threshold" population bases (market or customer base) needed by small businesses, services, and industries in rural communities in order to survive. (Swanson, 1984, p. iii) Perhaps there is also a need to determine if a threshhold farm population is necessary to fully protect the land under different agricultural production contexts. If it were determined that more people were needed to protect the land in certain areas, then some form of land reform or resettlement program for rural communities could be part of a redevelopment strategy for rural areas in need. Johnson pointed out that resettling of the land may be needed to "utilize

available land and to avoid increasingly expensive transportation." (Johnson, 1978, p. 13)

B. The Role of Values in the Paradigm Shift

If there is going to be a paradigm shift toward a more sustainable agriculture, it will require a major change of values. As Douglass explained, "Alternative agriculture, in short, implies not merely new techniques in food cultivation, but a new 'non-Promethean sensibility' toward land and society as a whole."(1984, p. 6) L. Brown agreed to the importance of values, suggesting that:

> Values are the key to the evolution of sustainable society not only because they influence behavior but also because they determine a society's priorities and thus its ability to survive. (L. Brown, 1981, p. 349)

Daly has argued that this value change of is a bigger transition than the institutional changes necessary. (1980, p. 348) The change of priorities is likely to be based either on personal experience or on intellectual insight. (Naegel, 1983, p. 15)

The fable of the golden goose teaches an important lesson to modern industrial society about agriculture. In that fable, the farmer was blessed with a goose which laid golden eggs. This was great for the farmer, except that the goose only laid one egg a day. Carried away with greed, the farmer cut the goose open to get more golden eggs. The goose died, of course, and there were no more golden eggs.

The orthodox approach to agriculture in North American is similar to that taken by the fabled farmer. Like that farmer, agribusiness suffers from a lust for short-term private benefit and an insensitivity to the complex and fragile nature of the agricultural ecosystems.

Agriculture, a potentially renewable and regenerative living system, is being transformed into an industrial system which is contributing to a global depletion and contamination of ecological and

social systems. In addition, the dynamics of this ecological and social decline is adding to the potential for eventual warfare over resources in an age when a nuclear war could destroy all life on earth.

In North America, where many modern industrial practices in agriculture originated, there is a growing awareness of a need for significant changes. Even among some industry advocates, there is a recognition of serious long-term problems in agriculture. Outlining a host of social and ecological problems in agriculture, a USDA report asked the U.S. public:

> ...do we want this to occur? What do we lose if it does occur? As this result would be practically irreversible, now is likely the last time society will have the opportunity to make the choice. If so, it ought to be a conscious choice, with full information about the trade-offs, not something that occurs by default. (USDA, 1979, pp. 4-5)

A new integrated scientific perspective, as outlined in this thesis could help society more informed choices about the future. Photos of earth coming from orbiting spaceships have brought a new, more practical, meaning to the traditional moral notion of the unity of humanity and life on earth. (Baric, 1981, p. 4 and Lovelock, 1985, p. 64) Lovelock's Gaian Hypothesis suggests that all life on this planet is part of a single unified living system. All living creatures are potentially essential for the survival of the whole. Moreover, the air, the soil, and the water protect and sustain life and are an integral part of the Gaian living system.

Along with the sense of belonging to the community of life which this notion implies, there is also an increased sense of responsibility incumbent upon the human race. Lovelock suggested that humanity may serve as the senses and nervous system for Gaia in that, "Through our eyes she has for first time seen her very fair face and in our minds become aware of herself."(Lovelock, 1985, p. 64) This role of humanity

as the "consciousness" of life on earth is especially critical in agriculture because, as Cobb argued, "In the global ecological horizon agriculture appears to be the most important human activity and sustainability the most important consideration."(1984, pp. 215-216)

C. Future Areas of Study

The conceptual model presented in Chapter VIII was designed to help evaluate alternative agriculture futures. The model reflects the inter-connected physical, biological, psychological, social and cultural levels of agricultural development; it recognizes that agricultural development is a balance between social development and ecological conservation; and it recognizes the critical importance of life's long-term struggle of life against entropy. By analyzing basic paradigm components in terms of their impact on these primary forces and interrelationships, the model has served as an analytical tool for evaluating agricultural development patterns and strategies from an integrated and comprehensive perspective.

Future studies of agricultural sustainability should attempt to assess in more depth whether Myrdal's principle of circular and cumulative causation applies to the decline and to the regeneration of agricultural systems. Much of the evidence presented in this study suggests there are causal relationships in agricultural development which would support Myrdal's hypothesis. When agricultural development is moving toward higher levels of entropy, there seems to be escalating levels of ecological and social breakdown. Conversely, when agricultural systems are directed by a concern for the health of the land, the people, and the communities based in agriculture, greater harmony seems to accumulate at physical, biological, psychological, social, and cultural levels.

The principle of circular and cumulative causation can be tested using the model presented in this study. A series of ecological and social indicators could be quantified and applied to appropriate circles of causality within the model. Sustainable, steady-state levels for these indicators would be located along the vertical "Axis of Sustainability." For example, the maximum sustainable level of soil erosion of five tons per acre per year might serve as a point along the "Axis of Sustainability." The circles for soil erosion indicators would be somewhere between the physical and biological. Higher levels of soil erosion would move down the circle toward the entropy axis, while lower levels would move toward the axis of living system transcendence. Other indicators could be quantified along other circles in a similar fashion.

By analyzing a variety of ecological and social indicators over a time series using this model, the trends within agriculture could be analyzed in a more holistic way. Such an analysis would go beyond current approaches to agricultural analysis. Through the use of this model, we may begin to reconceptualize agricultural development as a multilevel living system. In the process, we may also better recognize and understand the processes which would promote the long-term ecological and social sustainability of agriculture.

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